DIVISION 6 – STORMWATER MANAGEMENT

DIVISION 6

STORMWATER MANAGEMENT

601 GENERAL

601.01 AUTHORITY AND PURPOSE

601.01.A These Design Standards shall apply to all improvements within existing and proposed public right-of-way and public easements, to all improvements to be maintained by the City, and to all improvements for which the City Code requires approval by the City. Most of the elements contained in these Design Standards are public works oriented and it is intended that they apply to both publicly financed public improvements under City contract and privately financed public improvements.

601.01.B Private construction firms, Developers, consulting engineers, or any other individuals or business entities engaged in the design and construction of improvement projects that ultimately will be owned, operated, or maintained by the City shall comply in every respect with these standards. Where minimum values are stated, greater values should be used whenever practical; where maximum values are stated, lesser values should be used whenever practical.

601.01.C The purpose of these Design Standards is to provide a consistent policy under which certain physical aspects of public improvements shall be implemented. All public system improvements and public works facilities shall be designed and constructed in accordance with all applicable rules and regulations of the City and any City interpretations of those rules and regulations, including applicable technical guidance manuals, and in accordance with all applicable federal, state, and local statutes and rules. Approval of public improvements must be made by the City Engineer or the Public Works Director before construction is permitted. An authorized representative of the City will be available for construction observation during construction of the project.

601.01.D It is important to emphasize that these Design Standards are not intended to inappropriately restrict or constrain the originality or innovativeness of the Design Engineer and his or her ability to exercise and apply professional judgment to each situation and project. The City recognizes that every public improvement project has unique characteristics and situations. These Design Standards cannot provide for all situations and are intended to assist, but not to serve as a substitute for competent work by design professionals. It is expected that the Design Engineer will bring to each project the best of skills from the Design Engineer's respective discipline.

601.01.E If the Design Engineer anticipates challenges in meeting these Design Standards, they should contact the City Engineer prior to extensive design efforts. The City Engineer will seek to work with each designer to achieve a satisfactory design and construction project that is in the best long-term interests of the City of Stayton and one that complies with all applicable rules and regulations.

601.01.F These Design Standards are not intended to limit any innovative or creative effort which could result in better quality, better cost savings, or both. Any proposed departure from the Design Standards will be judged; however, on the likelihood that such variance will produce a comparable result, or long-term benefit to the City, in every way adequate for the intended purpose.

601.01.G Requests for alternatives to these Design Standards will be considered for approval by the City Engineer as the need arises and conditions warrant modification. Request must show that the variance meets the intent of the Design Standards and will not compromise safety, impact other properties or cause an increase in maintenance. This consideration will be on a case-by-case basis and require sufficient justification prior to approval.

601.01.H All franchise utility improvements, including telephone, electrical power, gas and cable TV shall meet the current standards of the appropriate agency as well as City Standards.

601.01.I In the case of conflicts between the text of these Design Standards and the Standard Drawings, or between the provisions of these Design Standards and the Standard Construction Specifications, the more stringent as determined by the City Engineer shall apply.

601.01.J All surveys for public works facilities shall be performed under the direction of a Professional Land Surveyor registered in the State of Oregon. All elevations shall be referenced to NGVD 29 vertical datum. Vertical benchmark locations shall be coordinated with the City.

601.01.K On completion of projects to become public works, the Design Engineer shall submit one complete set of reproducible "Record Drawings" (As-Builts), a compact disc (CD) containing electronic PDFs and cad files (AutoCAD version within 5 years of submittal, or others as approved) to the City Engineer. The drawings shall show any deviations from the original construction drawings and shall include sufficient information to accurately locate public works facilities. No bond will be released until the City Engineer receives an acceptable set of reproducible Record Drawings from the Design Engineer, with his/her stamp of certification.

601.01.L For privately financed public improvements, the Design Engineer, at the completion of construction, shall submit a completion certificate to the City stating that all work has been completed in accordance with the approved project plans and specifications.

601.01.M Before the City accepts a public works project for operation and maintenance, a one (1) year Warranty Bond on all materials and workmanship incorporated in the project shall be provided to the City.

601.01.N The objective of these Design Standards is to provide for a stormwater system that will:

- Be of adequate design to safely manage stormwater generated upstream and on the site from given storm intervals to an approved point of disposal.
- Provide points of connection for stormwater generated by future development upstream.
- Prevent the uncontrolled or irresponsible discharge of stormwater onto adjoining public or private property.
- Prevent the capacity of downstream channels and storm drainage facilities from being exceeded.
- Have sufficient structural strength to resist erosion and all external loads that may be imposed.
- Maintain the runoff characteristics of the original undeveloped drainage basin, where feasible, as determined by the City Engineer.
- Maximize efficient use of Stayton's natural drainage system of streams, lakes, and wetlands.
- Maintain or improve Stayton's overall stormwater quality.
- Be designed to be economical and safe to construct and maintain and shall incorporate best management practices.
- Be designed using materials to insure a minimum practical design life of seventy-five (75) years.

- ❖ Be consistent with the Stayton Municipal Code (SMC), Stayton Development Code, Stayton Standard Construction Specifications and all applicable state and federal regulations and requirements for stormwater quantity and quality.

601.02 APPLICABILITY

601.02.A These Design Standards will govern the design of all public drainage facilities in the City of Stayton and applicable work within its service areas. This document will be routinely referred to as the Design Standards. Permanent drainage facilities shall be provided on all property improvements within the City of Stayton per these Design Standards for the following types of development:

1. Partitions and subdivisions.

2. Commercial, industrial, and multifamily developments. These Design Standards are intended to fulfill the requirements of the "Special Storm Sewers" section of the State of Oregon Plumbing Specialty Code for private storm drains.

3. Developments entailing construction that would change the point of discharge of surface waters, the quantity of discharge, or discharge surface waters at a higher velocity or flow than that of the preconstruction discharge rate, or add to pollution of surface waters.

4. Construction or reconstruction of public roadways and temporary detours.

5. Developments entailing construction in or adjacent to any existing stream or surface watercourse including intermittent streams.

6. Developments requiring construction in or adjacent to the 100-year floodplain of any stream.

601.03 REFERENCES

601.03.A These Design Standards are intended to be consistent with the most current provisions of the documents and requirements listed and referenced in Subsection 101.03 and others specifically listed below. Projects are expected to be consistent with the following:

1. Applicable design criteria and concepts consistent with the most recent Stormwater Master Plan adopted by the City of Stayton unless more restrictive criteria are identified herein. Where additional detailed information and background is required for a particular project, the Stormwater Master Plan shall be referred and adhered to, as applicable. Any deviations from the Stormwater Master Plan shall be flagged and presented to the City Engineer for consideration.

2. State of Oregon Plumbing Specialty Code.

3. Applicable design guidelines published by the American Society of Civil Engineers.

4. Applicable design guidelines published by the Federal Highway Administration.

5. Applicable design guidelines published by the Oregon Department of Transportation.

6. Applicable stormwater and erosion control design manuals including, but not limited to, the following.

   - City of Portland Stormwater Management Manual
   - ODOT Hydraulics Manual
   - City of Portland Erosion and Sediment Control Manual
   - ODOT Erosion Control Manual
   - Oregon DEQ's Erosion and Sediment Control Manual

601.04 SPECIAL DESIGN APPLICATIONS

601.04.A Special design applications not covered in these Design Standards require review and approval by the City. Submittal of full design calculations, supplemental drawings, and information will be required prior to any approval.

601.04.B Such design applications requiring special review and approval include, but are not limited to, the following:

- Internal Sealing of Existing Storm Drains
- Relining of Existing Storm Drains
- Energy Dissipaters
- Bank protection

601.05 STANDARD CONSTRUCTION SPECIFICATIONS AND STANDARD DRAWINGS

601.05.A Except as otherwise provided by these Design Standards, all construction design detail, workmanship, and materials shall be in accordance with the current edition of the City of Stayton Public Works Standard Construction Specifications and Standard Drawings.

601.06 CITY POLICY REGARDING ENGINEERING

601.06.A It will be the policy of the City to require compliance with Oregon Revised Statute 672 for Professional Engineers.

601.06.B Engineering plans, reports, or documents shall be prepared by a registered Professional Engineer or by a subordinate employee under the Design Engineer's direction, and shall be signed by the Design Engineer and stamped with the Design Engineer's seal to indicate responsibility for them. The Design Engineer shall review any proposed public facility extension, modification, or other change with the City prior to engineering or other proposed design work to determine if there are any special requirements or whether the proposal is permissible.

601.06.C City approval of plans or any other engineering document produced by the Design Engineer does not in any way relieve the Design Engineer of responsibility to meet all applicable City, County, State, and Federal requirements, and the obligation to protect life, health, and property of the public. The plan for any project shall be revised or supplemented at any time it is determined that the project requirements have not been met.

601.07 CONVENTIONS USED THROUGHOUT THE DESIGN STANDARDS

601.07.A See Subsection 101.07 for conventions used throughout these Design Standards.

601.08 ORGANIZATION AND CLASSIFICATION OF DIVISIONS

601.08.A See Subsection 101.08 for the organization and classification of divisions throughout these Design Standards.

601.09 CLARIFICATIONS, MODIFICATIONS, AND REVISIONS TO DESIGN STANDARDS

601.09.A These Design Standards will be periodically updated due to changes in policy or procedures, new technology, and methods of design and construction. Periodic revisions to these Design Standards will be necessary to maintain consistency in that regard. The date appearing on the title page is the date of the latest revision for each Division. Parenthetical notations at the bottom of each page indicate the most recent change. It will be the user's responsibility to obtain and maintain his/her copy of these Design Standards with the latest changes.

601.09.B See Subsection 101.09 for general policies and procedures regarding clarifications, modifications, and revisions to the Design Standards.

601.10 DEFINITIONS AND TERMS

601.10.A See Subsection 101.10 for standard definitions and terms used throughout these Design Standards.

602 GENERAL DESIGN REQUIREMENTS

602.01 PERFORMANCE STANDARDS

602.01.A Storm drainage design shall meet the policies and guidelines of the latest Stormwater Master Plan and its updates. All stormwater that is or will be discharged to the City system shall comply with the Stayton Municipal Code requirements.

602.01.B Stormwater and groundwater, including but not limited to, street, roof, or footing drainage, shall not be connected to or will be allowed to discharge into any sanitary sewer system.

602.01.C For any project requiring construction within or adjacent to watercourses and/or wetlands, in addition to approval by the City, permits from the appropriate responsible agencies (Oregon Department of Fish and Wildlife, Oregon Division of State Lands, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, etc.) shall be obtained. Copies of all permits, or written evidence that no permit is required shall be given to the City prior to City approval of the construction plans.

602.01.D Storm drainage design within a development area shall include provisions to adequately control runoff from all public and private streets and the roof, footing, and area drains of residential, multifamily, commercial, or industrial buildings, and to insure future extension of the drainage system to the entire drainage basin in conformance with the Stayton Municipal Code and adopted Stormwater Master Plan. Control of both water quantity and quality shall be included as part of the design considerations. Provisions that must be met are:

1. Surface or subsurface drainage, caused or affected by the changing of the natural grade of the existing ground or removal of natural ground cover or placement of impervious surfaces, shall not be allowed to flow over adjacent public or private property in a volume and/or rate or location materially different from that which existed before development occurred, but shall be collected and conveyed in an approved manner to an approved point of disposal. Requirements of Building Codes shall also be met regarding alteration of drainage patterns.

2. Surface water entering the subject property shall be received at the naturally occurring locations and surface water exiting the subject property shall be discharged at the natural locations with adequate energy dissipators within the subject property to minimize downstream damage and with no diversion at any of these points.

3. The approved point of discharge for all stormwater may be a storm drain, existing open channel, creek, detention, or retention pond approved by the City Engineer, or subsurface as allowed and approved by DEQ. Acceptance of suggested systems will depend upon the prevailing site conditions, capacity of existing downstream facilities, and feasibility/maintainability of the alternate design.

4. All public storm drain systems shall be located within the public right-of-way or as directed and approved by the City Engineer. These storm drain systems are placed in the public right-of-way for ease of maintenance and access, control of the facility, operation of the facility, and to permit required replacement and/or repair. The City Engineer, under special conditions, may allow a public storm drain system to be located within a public storm drain easement as referenced in Subsection 102.08. When private property must be crossed in order to reach an approved point of discharge, it shall be the Developer's responsibility to acquire a recorded easement from the private property owner meeting the approval of the City Engineer. The Developer must secure all signed easement documents from private property owners prior to final plan approval.

5. The peak discharge from the subject property may not be increased from conditions existing prior to the proposed development, except where approved otherwise by the City Engineer.

6. Retention/detention facilities must be provided in order to maintain surface water discharge rates at or below the existing design storm peak discharge, except where it can be demonstrated by the applicant that no adverse impact will result from not providing said facilities, as approved by the City Engineer. The City Engineer may require a complete basin analysis to assure that the detention system does not adversely impact the operation of the storm drain system it is discharging to.

7. Storm drain system designs (conveyance, flow restrictions, detention) shall make adequate provisions for collecting all stormwater runoff. The system shall accommodate all runoff from upstream tributary areas whether or not such areas are within the proposed development. The amount of run-off to be accommodated shall be based upon ultimate development of all upstream tributary areas. Proposed storm drain systems shall not discharge flows into inadequate downstream systems.

8. An erosion and sediment control plan shall be developed for all phases of the project construction to protect downstream waters and minimize erosion.

9. Stormwater quality enhancements are encouraged and stormwater quality Best Management Practices (BMPs) shall be incorporated into the design.

10. All other local, State, and Federal permitting requirements must be met. The Developer shall produce copies of approved permits for the City prior to final plan approval.

602.02 STORM DRAINAGE PLANS

602.02.A Complete plans and specifications for proposed storm drain projects, including any necessary public dedications and easements, shall be submitted to the City Engineer for review. Such plans and specifications must receive City Engineer approval prior to construction permit issuance and prior to beginning of construction. Engineering documents shall be prepared by a Professional Engineer registered and licensed in the State of Oregon.

602.02.B Engineering design plans drawn to scale, showing the existing and proposed storm drain system, shall be submitted in accordance with Division 2 of these Design Standards. The proposed plan shall show profile and plan view of the proposed improvements.

602.03 PIPE MATERIALS AND SIZE

602.03.A Public storm drains shall be constructed with non-reinforced concrete pipe, reinforced concrete pipe, smooth interior, corrugated exterior HDPE pipe, or PVC pipe, as specified in the Standard Construction Specifications, unless approved otherwise. Pipe material shall be uniform throughout segmented manhole pipe runs. Tracer wire shall be a minimum 12-gauge, green-coated copper wire and shall be installed with all plastic pipe. Where required for added strength, Class 52 or greater ductile iron pipe or concrete pipe meeting the applicable Sections of ASTM C-76 shall be used. Regardless of selected pipe material, all joints shall be watertight.

602.03.B Public storm drain main lines (Collectors and Trunk lines) shall be a minimum of 12-inches in diameter. Public storm drain connector pipes to side-inlet catch basins and other inlet structures shall be a minimum of 10-inches in diameter.

602.03.C When two (2) parallel pipes are installed in-lieu-of one (1) large pipe or a box culvert, the minimum separation between the pipes shall be 1-foot or one-third the diameter of the largest diameter pipe, whichever is greater. This requirement may be waived if the void between the pipes below the spring line is filled by grouting, controlled-density fill, or other City approved method/substance.

602.04 STORM DRAIN SYSTEM CLASSIFICATION

602.04.A PRIVATE STORM DRAINS. A privately owned, operated, and maintained storm drain system which serves one or multiple building storm drains, catch basins, area drains, or other stormwater facilities located on private property outside rights-of-way or public easements. Private storm drains typically consist of the following:

- Private building roof drains, typically 3-inches in diameter.
- Private storm drains that are directly connected to public storm drain systems, where specifically allowed by the City Engineer, typically 6-inches in diameter.
- Private stormwater quantity and quality facilities, as required by the City Engineer.

602.04.B INLET CONNECTOR PIPES (sometimes also referred to as LATERALS). A public storm drain ten (10) inches in diameter to eighteen (18) inches in diameter which connects inlets (side-inlet catch basins, curb inlets, inlet manholes, and/or ditch inlets) to collector or trunk main storm drain systems. This portion of the system is designed to convey the ten-year frequency flow of the entire contributing area in an un-surcharged state. Inlet connector pipes terminate at the subsequent downstream point at which it connects to a collector main or trunk main storm drain system.

602.04.C COLLECTOR MAINS. A public storm drain main line twelve (12) inches in diameter and larger which accommodates one or more inlet connector pipes and/or other storm drain collector mains. This portion of the system is designed to convey the twenty-five year frequency flow of the entire contributing area in its fully developed land use condition. This portion of the storm drain system begins with a 12-inch or larger diameter pipe at the discharge point of the inlet connector pipes and terminates at the subsequent downstream point at which it is no longer capable of conveying the flow in an un-surcharged state in an 18-inch diameter pipe, at which point the system becomes a trunk storm drain system.

602.04.D TRUNK MAINS. A public storm drain main line twenty-one (21) inches in diameter and larger which one or more collector main lines and/or other storm drain trunk main lines connect or may connect. Trunk storm drain main lines may consist of man-made facilities such as pipes, ditches, and culverts or may consist of waterways. This portion of the system is designed to convey the fifty-year frequency flow of the entire contributing area in its fully developed land use condition, assuming on-site and/or regional detention has been incorporated in the design.

602.04.E CULVERTS. A stormwater conveyance system which provides for passage of water under or through traveled ways or obstructions placed across streams and waterways. Culverts shall be twelve (12) inches in diameter and larger for driveways and eighteen inches (18) in diameter and larger for crossings of street rights-of-way. Culverts shall be designed to at minimum convey the twenty-five year frequency flow of the entire contributing area and shall be designed to pass the required flows without compromising public safety or causing new or additional flooding. Culverts that convey flows from or through natural creeks, streams, flood hazards or other sensitive areas, or as otherwise deemed appropriate by the City Engineer, shall be designed to convey the one-hundred year frequency flow. Fish passage accommodations may be required on any creek and stream that has a history or the potential for fish production. In this case, a local representative of Oregon Department of Fish and Wildlife (ODFW) or other applicable state or federal agency shall be contacted by the Design Engineer to identify site-specific design criteria and to determine if fish passage is required.

602.05 DESIGN STORM RECURRENCE

602.05.A For design purposes, it is necessary to define the various parts of the storm drainage system and to specify the magnitude of flow that each part must be capable of carrying.

602.05.B Pipes, culverts, and ditches shall be designed to convey the peak discharge of the design storm recurrence interval shown in the following table.

DRAINAGE SYSTEM DESIGN CAPACITY		
DRAINAGE SYSTEM ELEMENT[1]		**DESIGN STORM RECURRENCE INTERVAL (YEARS)**
Minor	Surface drainage (driveways, streets, alleys, curbs, curbs and gutters, inlets) and inlet connector pipes.	10
Major	Collector Mains < 20 tributary acres	25
	Trunk Mains > 20 tributary acres	50 [2]
	Arterial Streets and the drainage system in or under Arterial Streets	50 [2]
Watercourses	Without designated floodplain	50
	With designated floodplain	100
Bridges	All	100
Detention Facilities	Minor (onsite) – Storage volume	See Section 608
	Major (Regional) – Storage volume	See Section 608
	Discharge rate	Limited to pre-development flow rates (function of downstream capacity) See Section 608
Retention Facilities [3]	Infiltration capacity	25

Notes:

1. *Conveyance system adequacy shall be demonstrated by performing a backwater analysis.*
2. *Surcharged conditions for pipe systems and culverts and bank-full conditions for open ditches and channels are acceptable only for demonstrating the adequacy of the conveyance system to convey the peak runoff for the 25 or 50-year design storms (as required) provided that:*
   - *Runoff is contained within defined conveyance system elements.*
   - *Hydraulic grade line does not exceed the elevation of the roadway subgrade.*
   - *No portions of a building will be flooded.*
3. *Only as approved by City Engineer. Design shall be in conformance with DEQ requirements, as applicable. Where approved, drywells shall have a maximum allowable design capacity of 1200 GPM = 2.67 CFS per drywell.*

603 MINIMUM DESIGN CRITERIA

603.01 DRAINAGE CALCULATIONS AND REPORT

603.01.A Calculations for storm drain design shall be submitted with all storm drain improvement projects. Calculations shall clearly show how flows were calculated and also how the proposed storm system is capable of conveying these flows. For projects that require detention, full pre-development and post-development calculations shall be submitted.

603.01.B Basin maps shall be submitted with all calculations and shall show clearly how stormwater is being routed through the improvements.

603.01.C The Drainage Report shall be on 8-1/2" x 11" paper and maps shall be folded to 8-1/2" x 11" size unless another format is approved prior to submittal.

603.01.D The Drainage Report shall be prepared by and bear the seal and original signature of a Professional Engineer registered in the State of Oregon and shall contain the following information:

1. Cover Sheet, including the project name, land use authority case file number, proponent's name, address and telephone number, Design Engineer, and date of submittal.

2. Table of Contents, with the page numbers for each section of the report, including exhibits, appendices, and attachments.

3. Vicinity Map.

4. Project Description: Describe the type of permit(s) for which the proponent is applying, the size and location of the project site, address or parcel number and legal description of the property, property zoning. Also describe other permits required (e.g. Corps of Engineers 404 Fill Permit, DEQ Erosion Control Permits, etc). Describe the project, including proposed land use, proposed site improvements, proposed construction of impervious surfaces, proposed landscaping, and special circumstances.

5. Existing Conditions:

    a. Describe existing site conditions and relevant hydrological conditions including but not limited to:

        - ❖ Project site topography;
        - ❖ Land cover and land use;
        - ❖ Abutting property land cover and land use;
        - ❖ Offsite drainage to the property;
        - ❖ Natural and constructed channels;
        - ❖ Sensitive areas, wetlands, creeks, ravines, gullies, steep slopes, springs and other environmentally sensitive areas on or adjacent to the project site.
        - ❖ Seasonal groundwater levels for subsurface system components (i.e., lines, detention ponds, underground storage, etc.)

    b. General soils conditions present within the project site, using SCS soil designations.

    c. Points of discharge for existing drainage from the project site.

    d. Include references to relevant reports such as basin plans, flood studies, groundwater studies, wetland designation, watershed plans, subbasin master plans, sensitive area designation, environmental impact statements, stormwater quality reports, or other relevant documents. Where such reports impose additional conditions on the Proponent, those conditions shall be included in the report.

    e. Soils Report(s), where applicable.

    f. Hydrologic Analysis

    g. Basin Map(s), showing boundaries of project, any offsite contributing drainage basins, onsite drainage basins, approximate locations of all major drainage structures within the basins, and depicting the course of stormwater originating from the subject property and extending all the way to the closest receiving body of water. Reference the source of the topographic base map (e.g. USGS), the scale of the map, and include a north arrow.

h. Drainage Basin Description: Describe the drainage basin(s) to which the project site contributes runoff, and identify the receiving waters for each of these drainage basins.

i. Relation to Storm Drain Master Plan: Describe how the project complies with, or will impact (if not shown), the Storm Drain Master Plan.

j. Developed Site Drainage Conditions: Describe the land cover resulting from the proposed project; describe the potential stormwater quantity and quality impacts resulting from the proposed project; describe the proposal for the collection and conveyance of site runoff from the project site, for the control of any increase in stormwater quantity resulting from the project, and for the control of stormwater quality.

k. Description of upstream basins, identifying any sources of runoff to the project site. This should be based on field investigation. Any existing drainage or erosion issues upstream that may have an impact on the proposed development should be noted.

l. Downstream analysis, include a summary table comparing the pre-developed and post-developed hydraulic analysis for all discharge points.

m. Hydraulic Design Computations, supporting the design of all proposed stormwater conveyance, quantity and quality control facilities, and verifying the capacity of existing and proposed drainage facilities. These computations may include capacity and backwater analysis required either as part of the proposed drainage design or as part of the downstream drainage investigation, and flood routing computations required for the design of detention/retention storage facilities, for wetland impact analysis, or for floodplain analysis. A description on how the stormwater system will function during the water quality storm, 2-year storm, 25-year storm and the 100-year storm shall also be included.

n. Maintenance and Operation Manual: Required for privately owned and maintained stormwater quantity and quality control facilities. This manual will be an attachment to the maintenance covenant.

o. Appendices: Shall include technical information as necessary.

603.02 HYDROLOGY

603.02.A GENERAL

1. The Design Engineer is not limited to any one analytical method for hydrologic calculations.

2. Design Engineers are encouraged to use FEMA flow quantities for FEMA regulated waterways and Storm Drain Master Plan flow quantities when available for other waterways.

603.02.B RATIONAL METHOD

1. GENERAL

   a. The rational method for analyzing small drainage basins may be used with the following limitations:

      1) Only for use in predicting a conservative peak flow rate to be used in determining the required capacity for conveyance elements.

      2) Drainage subbasin area cannot exceed 25 acres for a single calculation without approval from the City.

      3) The time of concentration shall be five minutes when computed to be less than five minutes.

2. RATIONAL FORMULA

   a. EQUATION:

$$Q = C_F * C * I * A$$

Where,

Q = peak flow in cubic feet per second.
C_F = a runoff coefficient adjustment factor to account for reduction of infiltration and other losses during high intensity storms.
C = a runoff coefficient determined by ground cover. The engineer must document the methodology used in determining the value proposed.
I = rainfall intensity in inches per hour. Rainfall intensity found on the ODOT Zone 8, I-D-F curve (as shown in Section 611) shall be used. For the Rational Method, the basin time of concentration is used as the storm duration. The time of concentration must first be calculated (see Time of Concentration below), and then the rainfall intensity can be read from the I-D-F curve.
A = the basin area in acres.

   b. RUNOFF COEFFICIENT "C"

      1) The runoff coefficient is often difficult to estimate because it represents the interaction of many complex factors including surface ponding, infiltration, antecedent moisture, ground cover conditions, ground slopes, and soil type. The actual runoff coefficient for a given drainage basin can best be approximated by calculating a weighted average of all distinct surface types:

$$_{AVG}C = \frac{\sum(C_{i\ AREAS})(A_{i\ AREAS})}{A_{TOTAL\ AREA}}$$

Where,

$_{AVG}C$ = the weighted average C-value for the drainage basin.
$C_{i\ AREAS}$ = individual C-values for distinct surface types within a subbasin.
$A_{i\ AREAS}$ = individual areas for distinct surface types within a subbasin.
$A_{TOTAL\ AREA}$ = total area of the drainage basin.

2) The impervious surface area is often a factor in stormwater storage and stormwater quality treatment designs. Impervious surfaces have runoff coefficients greater than 0.80 based on the Table below.

RUNOFF COEFFICIENTS "C" (for Rational Method)			
Surface Type	**Flat (0 - 2%)**	**Rolling (2% to 10%)**	**Hilly (Over 10%)**
Pavement & Roofs	**0.90**	**0.90**	**0.90**
Earth Shoulders of Roadways	0.50	0.50	0.50
Drives & Walks	0.75	0.80	**0.85**
Gravel Surfacing	**0.85**	**0.85**	**0.85**
City Business Areas	0.80	**0.85**	**0.85**
Apartment Dwelling Areas	0.50	0.60	0.70
Light Residential: 1 to 3 units/acre	0.35	0.40	0.45
Normal Residential: 3 to 6 units/acre	0.50	0.55	0.60
Dense Residential: 6 to 15 units/acre	0.70	0.75	0.80
Lawns	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.60	0.60	0.60
Side Slopes, Turf	0.30	0.30	0.30
Median Areas, Turf	0.25	0.30	0.30
Cultivated Land, Clay & Loam	0.50	0.55	0.60
Cultivated Land, Sand & Gravel	0.25	0.30	0.35
Industrial Areas, Light	0.50	0.70	0.80
Industrial Areas, Heavy	0.60	0.80	**0.90**
Parks & Cemeteries	0.10	0.15	0.20
Playgrounds	0.20	0.25	0.30
Woodland & Forests	0.10	0.15	0.20
Meadows & Pasture Land	0.25	0.30	0.35
Unimproved Areas	0.10	0.20	0.30

*Note: Impervious surfaces shown in **bold.***

c. RUNOFF COEFFICIENT ADJUSTMENT FACTOR "C_F" – The Coefficients in the Table above are applicable for 10-years or less recurrence interval storms. Less frequent, higher intensity storms require adjusted runoff coefficients because infiltration and other losses have a proportionally smaller effect on runoff. Runoff coefficient adjustment factors (C_F) for storms of different recurrence intervals are listed in the table below.

Recurrence Interval	Runoff Coefficient Adjustment Factor (C_F)
10 years or less	1.0
25 years	1.1
50 years	1.2
100 years	1.25

d. RAINFALL INTENSITY "I" – This variable indicates rainfall severity. Rainfall intensity is related to rainfall duration and design storm recurrence interval. Rainfall intensity at a duration equal to the time of concentration (Tc) is used to calculate the peak flow in the Rational Method. Calculations for Time of Concentrations are shown in Subsection 603.02.D below. Once the time of concentration is known, the rainfall intensity can be selected from the ODOT Zone 8 I-D-F curve shown in Section 611.

603.02.C HYDROGRAPH METHOD

1. GENERAL

a. Drainage subbasins which exceed 25 acres for a single calculation shall use the hydrograph analysis method unless otherwise approved in advance by the City. The physical characteristics of the site and the design storm shall be used to determine the magnitude, volume and duration of the runoff hydrograph. The Santa Barbara Urban Hydrograph (SBUH) is the primary acceptable hydrograph method. However, other acceptable methods include the Natural Resources Conservation Service (NRCS) TR-20 method, the TR-55 method, or other similar methods. If a software package is used, documentation of the software's processing and methodology shall be submitted with the results. All input and assumptions shall be clearly documented. The typical input information needed for the hydrograph method is:

- Rainfall Distribution
- Total 24-hour Rainfall
- Time of Concentration (see Subsection 603.02.D)
- Basin Area
- Curve Number (CN)

b. Trunk main lines and all improvements that require detention shall be designed only after a full analysis of the basins contributing to the improvements is completed. Hydrographs for all basins shall be developed.

2. RAINFALL DISTRIBUTION

   a. The rainfall distribution to be used within the City is the design storm of 24-hour duration based on the standard NRCS Type 1A rainfall distribution as shown in Section 611.

3. 24-HOUR RAINFALL FOR STAYTON

   a. The 24-hour rainfall totals for the given return intervals shall be in accordance with the rainfall depths presented in the Stormwater Master Plan, as shown below.

Return Interval	Peak 24-Hour Rainfall
2 year	2.70 inches
5 year	3.20 inches
10 year	3.50 inches
25 year	4.00 inches
50 year	4.40 inches
100 year	4.70 inches

4. BASIN AREA

   a. To obtain the highest degree of accuracy in hydrograph analysis, requires the proper selection of homogeneous basin areas. Significant differences in land use within a given basin must be addressed by dividing the basin area into subbasin areas of similar land use and/or runoff characteristics. Hydrographs should be computed for each subbasin area and superimposed to form the total runoff hydrograph for the basin.

   b. All pervious and impervious areas within a given basin or subbasin shall be analyzed separately. This may be done by either computing separate hydrographs or computing the precipitation excess. The total precipitation excess is then used to develop the runoff hydrograph. By analyzing pervious and impervious areas separately, the cumulative errors associated with averaging these areas are avoided and the true shape of the runoff hydrograph is better approximated.

5. RUNOFF CURVE NUMBERS

   a. GENERAL

      1) Runoff curve numbers were developed by the Natural Resources Conservation Service (NRCS) (formerly referred to as the Soil Conservation Service (SCS)) after studying the runoff characteristics of various types of land. Curve numbers (CN) were developed to reduce diverse characteristics such as soil type, land usage, and vegetation into a single variable for doing runoff calculations. The approved runoff curve numbers are included in Section 611.

      2) The curve numbers presented in Section 611 are for wet antecedent moisture conditions. Wet conditions assume previous rainstorms have reduced the capacity of soil to absorb water. Given the frequency of rainstorms in the City, wet conditions are most likely, and give conservative hydrographic values.

3) The following are important criteria/considerations for selection of CN values:

a) Many factors may affect the CN value for a given land use. For example, the movement of heavy equipment over bare ground may compact the soil so that it has a lower infiltration rate and greater runoff potential.

b) CN values can be area weighted when they apply to pervious areas of similar CN (within 20 CN points). However, high CN areas should not be combined with low CN areas (unless the low CN areas are less than 15 percent of the subbasin).

c) Antecedent soil moisture values should be considered. Soil should be considered to be moist prior to the start of the precipitation event.

b. HYDROLOGIC SOIL GROUP DESCRIPTION – Curve Numbers have been assigned to one of four hydrologic soil groups, according to their runoff characteristics as described below:

1) Group A Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

2) Group B Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

3) Group C Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

4) Group D Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a fragipan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

c. CURVE NUMBER EQUATIONS:

1) The area's potential maximum storage capacity, S, is related to its curve number, CN:

$$S = (1000 / CN) - 10$$

2) The rainfall-runoff equations of the NRCS curve number method relate a land area's runoff depth (precipitation excess) to the precipitation it receives and to its natural storage capacity, as follows:

$$Q_{INCHES} = \frac{(P - 0.2S)^2}{(P + 0.8S)} \quad \text{for P > 0.2S; and}$$

$$Q_{INCHES} = 0 \quad \text{for P < 0.2S}$$

Where,

Q_{INCHES} = runoff depth in inches over the area
P = precipitation depth in inches over the area
S = potential maximum storage capacity, in inches over the area, due to infiltration, storage, etc.

3) The computed runoff represents inches over the tributary area. Therefore, the total volume of runoff is found by multiplying Q_{INCHES} by the area (with necessary conversions):

a) Total Runoff Volume (cubic-feet) = Q_{INCHES} (in) x A (ac) x 3,630 (cubic-feet/(ac-in))

4) When developing the runoff hydrograph, the above equation for Q_{INCHES} is used to compute the incremental runoff depth for each time interval from the incremental precipitation depth given by the design storm hyetograph. This time distribution runoff depth is often referred to as the precipitation excess and provides the basis for synthesizing the runoff hydrograph.

603.02.D TIME OF CONCENTRATION

1. Time of concentration is a very important variable in determining runoff volumes and peak flows. Time of concentration calculations shall be submitted for review. There are three components that shall be considered when determining time of concentration: OVERLAND SHEET FLOW (T_{OSF}), SHALLOW CONCENTRATED FLOW (T_{SCF}), and CHANNEL/PIPE FLOW (T_{CPF}). The three runoff flow time components shall be calculated separately and then added together to determine the total basin time of concentration.

2. OVERLAND SHEET FLOW – Overland sheet flow is shallow flow over a plane surface. It occurs in the furthest upstream segment of the drainage path, which is located immediately downstream from the drainage divide. The length of the overland sheet flow segment is the shorter of (1) the distance between the drainage divide and the upper end of a defined channel, or (2) a distance of 300 feet. For the first 300 feet of overland flow, the sheet flow time of concentration can be calculated using the following equations.

a. KINEMATIC WAVE METHOD (for use with IDF curves): Overland sheet flow of runoff to the initial catchment point into the storm drain system shall be a minimum of 5 minutes.

$$T_{OSF} = \frac{0.93L^{0.6}n^{0.6}}{I^{0.4}S_o^{0.3}}$$

Where,

T_{OSF} = Travel time for the overland sheet flow segment in minutes.
L = Length of overland flow in feet (300 feet max).
n = Manning's Roughness Coefficient.
I = Rainfall intensity in inches per hour.
S_O = The average slope of overland area in feet per feet.

b. MANNING'S KINEMATIC SOLUTION (for use with NRCS method). Overland sheet flow of runoff to the initial catchment point into the storm drain system shall be a minimum of 5 minutes.

$$T_{OSF} = \frac{0.007(nL)^{0.8}}{P_2^{0.5}S_o^{0.4}}$$

Where:

Tt= Travel time for the overland sheet flow segment in hours.
n = Manning's roughness coefficient.
L = Length of flow in feet
P_2= 2-year, 24-hour rainfall in inches.
S_O = The average slope of overland area in feet per feet.

Surface Type	Manning's n
Pavement & Roofs	0.014
City Business Areas	0.014
Graveled Surfaces	0.020
Apartment Dwelling Areas	0.050
Industrial Areas	0.050
Urban Residential Areas (more than 6 units/acre)	0.080
Meadows, Pastures, & Range Land	0.150
Rural Residential Areas (more than 6 units/acre)	0.240
Playgrounds, Light Turf	0.240
Parks & Cemeteries, Heavy Turf	0.400
Woodland & Forests	0.400

3. SHALLOW CONCENTRATED FLOW

a. To determine the flow time of runoff in the shallow concentrated flow regime, the flow velocity will need to be estimated. The average velocity is a function of watercourse slope and surface type and can be approximated using the figure shown in Section 611 (*source: ODOT Hydraulics Manual, originally from the 1972 Soil Conservation Service Handbook)*. For slopes less than 0.005 feet per feet, the following equations can be used to determine the average flow velocity of the shallow concentrated flow.

For unpaved Surfaces: $V = 16.1345 * (S)^{0.5}$

For paved Surfaces: $V = 20.3282 * (S)^{0.5}$

Where:

V = Velocity in feet per second
S = Slope in feet per feet

b. Once velocity is calculated, divide the distance of flow by velocity to get flow time in which the travel time for the concentrated flow segment can be calculated as follows:

$$T_{SCF} = \frac{L}{60V}$$

Where,

T_{SCF} = Travel time for the shallow concentrated flow segment in minutes.
L= Length of the shallow concentrated flow segment in feet.
V = Average flow velocity in feet per second.

4. CHANNEL/PIPE FLOW

a. The Manning Formula shall be used to calculate velocities in channels and pipes. Flow length shall then be divided by the velocity to get flow time. The Manning Formula is expressed by the following equation.

$$V = (1.486/n) * (R^{(2/3)}) * (S^{0.5})$$

Where:

V = Mean velocity of flow in feet per second (V=Q/A).
n = Manning's n, 0.013 minimum for pipe.
R = Hydraulic Radius in feet, defined as the area of flow divided by the wetted perimeter (A / WP);
A = cross sectional flow area in square feet.
WP = wetted perimeter in feet.
S = Slope of hydraulic grade line in feet per feet.

b. Once velocity is calculated, divide the distance of flow by velocity to get flow time in which the travel time for the concentrated flow segment can be calculated as follows:

$$T_{CPF} = \frac{L}{60V}$$

Where,

T_{CPF} = Travel time for the channel/pipe flow in minutes.
L= Length of the channel/pipe flow segment in feet.
V = Average flow velocity in feet per second.

c. Note that new PVC or HDPE pipe likely have a manufacturer's "n" value of approximately 0.009. However, regardless of pipe material, sand, grit, and slime will build up on pipe walls. This results in true "n" values over time of approximately 0.013. As a consequence, a Manning coefficient of 0.013 shall be used for design of PVC or HDPE piping systems. If an alternative piping material is approved, either the pipe manufacturer's recommended coefficient shall be used or an "n" value of 0.013, whichever is greater.

603.02.E SUPPORTING DATA

1. Time of concentration calculations shall be submitted along with a map showing the assumed flow path, drainage basins areas, rainfall intensity, and other necessary information.

2. Background computations for sizing drainage facilities shall include:

   a. Peak discharge rate and volume of surface water for the design storm currently entering and leaving the subject property; or if the City Engineer determines that the property is in an interim flood hazard area, then a 50-year storm shall be used. Discharge volumes shall be computed for both the current land use conditions and full development of the tributary basin area.

   b. Peak discharge and rate of runoff that will be generated within the subject property due to the design storm after development occurs.

   c. Peak discharge and rate of runoff that will be generated by the design storm at all naturally occurring points of discharge from the property (cubic feet per second, predevelopment, and post-development.) For projects that require detention, 2-year, 10-year, and 25-year storms must be analyzed.

   d. The proposed methods of handling, storing, and discharging of peak loads:

      1) Proposed improvement for handling the computed runoff, including the location and capacity of all natural or proposed drainage facilities and easements. The method of discharging storm drainage offsite at the naturally occurring location and provisions needed to control the velocity, volume, and direction of the discharge in order to minimize damage to other properties, stream banks, and overall stormwater quality.

      2) Drawings of proposed open channel and closed conduit system.

      3) Proposed cross-section of the channel with stable side slopes.

4) For open channel improvements, the water surface elevation (backwater curve) of the flow for the design storm shall be indicated on the cross-section.

5) For closed conduit improvements, the hydraulic grade line (HGL) of the flow for the design storms shall be indicated on the cross-section.

603.02.F DOWNSTREAM ANALYSIS

1. For each development constructing new impervious surface of more than 1,000-square feet, the Design Engineer shall submit documentation of the downstream capacity of any existing storm facilities impacted by the proposed development. The Design Engineer shall perform an analysis of the drainage system downstream of the development to a point in the drainage system where the proposed development site constitutes 10 percent or less of the total tributary drainage volume, but in no event less that 1/4-mile.

2. If the capacity of any downstream public storm conveyance system or culvert is surpassed, due directly to the development, the Developer shall correct (mitigate) the capacity problem and/or construct an on-site detention facility.

3. If the projected increase in surface water runoff which will leave a proposed development will cause or contribute to damage from flooding to existing buildings or dwellings, the downstream stormwater system shall be enlarged to relieve the identified flooding condition prior to development, or the Developer shall construct an on-site detention facility.

4. Any increase in downstream flow will be reviewed for erosion potential, defined as downstream channels, ravines, or slopes with evidence of erosion/incision sufficient to pose a sedimentation hazard to downstream conveyance systems or pose a landslide hazard by undercutting adjacent steep slopes.

5. The downstream analysis is to be divided sequentially into three parts: REVIEW OF RESOURCES; INSPECTION OF THE AFFECTED AREA; AND ANALYSIS OF DOWNSTREAM EFFECTS.

   a. REVIEW OF RESOURCES. During the review of resources, the Design Engineer shall review any existing data concerning drainage of the project area. This data will commonly include area maps, floodplain maps, wetland inventories, stream surveys, habitat surveys, engineering reports concerning the entire drainage basin, inventories of known drainage problems, and previously completed downstream analyses. The City may be able to provide most of this information. Other sources of information include, Oregon Department of Environmental Quality, Oregon Division of State Lands, Department of Fish and Wildlife, and other local agencies.

   b. INSPECTION OF THE AFFECTED AREA. During the inspection of the affected area, the Design Engineer shall physically inspect the drainage system at the project site and downstream of the site. During the inspection, the Design Engineer shall investigate any problems or areas of concern that were noted during the review of resources. The Design Engineer shall also identify any existing or potential capacity problems in the drainage system, any existing or potential areas where flooding may occur, any existing or potential areas of channel destruction (including erosion and sedimentation), and existing or potential areas of significant destruction of aquatic habitat.

c. ANALYSIS OF THE DOWNSTREAM EFFECTS. During the analysis of downstream effects, the information that has been gathered shall be analyzed to determine if construction of the project will create any drainage problems downstream or will make any existing problems worse. Often, if the other minimum requirements are met, the project will not negatively impact the downstream drainage system. There are however some situations that, although minimum requirements have been met, will still have negative impacts. Whenever a situation is encountered where it has been determined that there will be negative impacts resulting from the project, mitigation measures shall be included in the project to correct for the impacts.

603.03 VELOCITY AND SLOPE

603.03.A Storm drains shall be laid on a grade that will produce a mean velocity (when flowing full) of at least 3-feet per second, based upon Manning's pipe friction formula using a roughness coefficient valued at not less than 0.013, or the pipe manufacturer's recommendations, whichever is greater. An “n” value of less than 0.013 will not be considered for approval.

603.03.B The minimum slope may be reduced to produce an absolute minimum velocity of 2.5 fps upon approval of the City Engineer. But the grade of any pipe, regardless of diameter, shall not be less than .002-feet/foot unless otherwise authorized by the City Engineer. Other cases requiring a flatter slope than permitted above shall also be reviewed on a case-by-case basis for approval by the City Engineer. Design Engineers are cautioned not to specify storm drains of sizes that are obviously larger than is necessary for satisfactory carrying capacity, but which are specified solely in order to meet grade requirements, i.e., a 12-inch pipe for a 10-inch pipe to acquire a decrease in slope.

603.03.C The maximum grade for storm drains will generally be limited such that pipeline velocities when flowing full do not exceed 15-feet/second. If, out of necessity, velocities greater than this will result, ductile iron piping shall be used. Outside drop manholes with flatter pipe slopes can also be used.

603.03.D Where velocities in storm drains greater than 15-feet/second are attained, special provisions shall be made to protect structures against erosion and displacement by shock. Specific approval will be required from the City Engineer.

603.03.E Storm drains laid on slopes greater than 15 percent, or as recommended by pipe manufacturer for slopes 15 percent and less, shall be secured by anchor walls in accordance with the Standard Drawings. Anchor walls located at the middle of pipe runs of less than 200 feet between structures are generally adequate, but for spans greater than 200 feet, anchor walls shall not exceed a spacing of 100 feet. Specific approval for slopes greater than 15 percent will be required from the City Engineer.

603.04 HYDRAULIC DESIGN

603.04.A The Design Engineer shall submit calculations for each public storm drain system to be installed. The hydraulic design of storm drains shall be in accordance with the most current edition of the following:

- Hydraulic Engineering Circular No. 22 (FHWA-TS-84-202) Drainage of Highway Pavements.

603.04.B When calculating volumes, slopes, and velocities, the Manning Formula shall be used. Note that new PVC or HDPE pipe likely have a manufacturer's "n" value of approximately 0.009. However, regardless of pipe material, sand, grit, and slime build up on pipe walls. This results in true "n" values over time of approximately 0.013. As a consequence, a Manning coefficient of 0.013 shall be used for design of PVC or HDPE piping systems. If an alternative piping material is approved, either the pipe manufacturer's recommended coefficient shall be used or an "n" value of 0.013, whichever is greater.

603.04.C The Manning Formula is expressed by the following equation:

$$V = (1.486/n) * (R^{(2/3)}) * (S^{0.5})$$

Where:

V = Mean velocity of flow in feet per second (V=Q/A).
n = Manning's n, 0.013 minimum for pipe.
R = Hydraulic Radius in feet, defined as the area of flow divided by the wetted perimeter (A / WP);
A = cross sectional flow area in square feet.
WP = wetted perimeter in feet.
S = Slope of hydraulic grade line in feet per feet.

603.04.D In terms of discharge, the above equation becomes:

$$Q = (1.486/n) * A * (R^{(2/3)}) * (S^{0.5})$$

Where:

Q = rate of flow in cubic feet per second
V = Mean velocity of flow in feet per second (V=Q/A).
n = Manning's n, 0.013 minimum for pipe.
R = Hydraulic Radius in feet, defined as the area of flow divided by the wetted perimeter (A / WP);
A = cross sectional flow area in square feet.
WP = wetted perimeter in feet.
S = Slope of hydraulic grade line in feet per feet.

603.04.E For storm drains flowing full, the above equations become:

$$Q = (0.463/n) * (D^{(8/3)}) * (S^{0.5})$$

Where:

D = diameter of pipe in feet

603.04.F The Manning's equation can be written to determine friction losses for storm drains as:

$$H_F = (29.14 * n^2 * L * V^2) / (R^{(4/3)} * 2g)$$

Where:

H_F = total head loss due to friction, ft;
n = Manning's n, 0.013 minimum for pipe;
L = length of pipe, ft;
V = mean velocity, ft/s;
R = hydraulic radius, ft;
g = acceleration of gravity, 32.2 ft/s^2.

603.04.G Assume a trial pipe size and solve Manning's formula for the slope, S. If the computed slope is greater than the actual slope, the pipe is flowing full and is pressurized. It is desirable to use a pipe size which flows nearly full, but is not pressurized. Therefore, either adjust the pipe flow line to a steeper slope, or choose a larger pipe size and repeat the calculation. Minimum pipe sizes criteria or inlet control may control in many cases.

603.04.H Complete similar calculations for each segment of pipe in the system being careful to carry adjusted flow lines to subsequent calculations. With the initial system tabulated, check for conflicts with utilities, minimum cover requirements, and manhole spacing requirements. Adjust and redesign as necessary.

603.04.I HYDRAULIC GRADE LINE

1. The hydraulic grade line (HGL) shall be evaluated as part of the design. The HGL represents the water surface elevation of the flow traveling through the storm drain system. If the HGL becomes higher at a manhole or inlet than the rim elevation of that structure, flow will leave the storm drain. This can cause severe traffic safety problems and must always be avoided.

2. Typically when velocities in storm drains are moderate (less than 6 ft/s), energy losses are insignificant and can typically be ignored. However, when flow velocities become higher, energy losses need to be calculated. Once energy losses are calculated, the HGL can be calculated to determine if the storm drain will function properly.

3. Hydraulic grade line calculation procedures are shown in most current edition of the following:

   - ❖ Hydraulic Engineering Circular No. 22 (FHWA-TS-84-202) Drainage of Highway Pavements.

603.05 CULVERTS

603.05.A Culverts shall be designed to at minimum convey the twenty-five year frequency flow of the entire contributing area and shall be designed to pass the required flows without compromising public safety or causing new or additional flooding. Culverts shall be minimum twelve (12) inches in diameter for driveways and minimum eighteen inches (18) in diameter for crossings of street rights-of-way.

603.05.B Culverts that convey flows from or through natural creeks, streams, flood hazards or other sensitive areas, or as otherwise deemed appropriate by the City Engineer, shall be designed to convey the one-hundred year frequency flow.

603.05.C Water crossing structures on all creeks and tributaries shall be constructed and maintained so as to not impede or eliminate a native fish species' access to habitat or ability to migrate. Proposed culvert crossings, regardless of tributary size, intermittent or perennial, shall conform to Oregon Department of Fish & Wildlife and National Marine Fisheries Service's regulations and stream crossing guidelines.

603.05.D Culvert headwater water surface elevations shall not exceed 1.5-times the culvert diameter or shall remain at least 1-foot below the roadway subgrade, whichever is less.

603.05.E Culverts shall be designed in accordance with the most current version of the ODOT Hydraulics Manual or other design manual as approved by the City Engineer.

603.06 BRIDGES

603.06.A New and replacement bridges over natural perennial channels shall be designed to pass the 100-year peak discharge from the tributary area assuming full development. Unless approved otherwise, vertical clearance between the design water surface and the bottom of any part of the bridge shall be a minimum of 2-feet or 25 percent of the mean channel width between ordinary high water marks at the crossing, whichever is greater. Bridge hydraulics shall be designed in accordance with the most current version of the ODOT Hydraulics Manual or other design manual as approved by the City Engineer.

603.07 ENERGY DISSIPATORS

603.07.A Energy dissipators shall be designed in accordance with the most current version of the ODOT Hydraulics Manual or other design manual as approved by the City Engineer.

603.08 FLOODPLAIN INFORMATION

603.08.A Floodplain information, delineating the floodway and 100-year floodplain limits, shall be shown where it occurs within the development. Floodplain limits shall be based on maps prepared by the U.S. Army Corps of Engineers and the Federal Emergency Management Agency (FEMA). Where better information is available, it shall be used. The Design Engineer is cautioned about placing fill material or obstructions within the delineated floodplain limits.

604 ALIGNMENT AND COVER

604.01 RIGHT-OF-WAY LOCATION

604.01.A Storm drain systems shall be located in the street right-of-way and shall generally be located 5-feet south or west from right-of-way centerline as shown in the Standard Drawings. Any deviations will be reviewed on a case-by-case basis and will require City approval.

604.01.B Curved alignments in stormwater systems, vertically or horizontally, are not permitted.

604.01.C All changes in direction and size of pipe shall be made at an approved structure.

604.01.D Under normal conditions, storm drains shall be on the low side and on the south and west sides of the street, except when inlet locations warrant otherwise. Piping between inlets and storm drain lines shall be at near right angles to the street and other utility lines. All exceptions shall be reviewed on a case-by-case basis for approval.

604.01.E Where storm drains are being designed for installation parallel to other utility pipe or conduit lines, the vertical location shall be in such a manner that will permit future side connections of storm drains and avoid conflicts with parallel utilities without abrupt changes in vertical grade of main or lateral storm drains. A minimum separation of 5-feet clear distance shall be maintained between storm drain lines and all other public utilities.

604.01.F Where approved by the City Engineer, public storm drains serving a master planned development, apartment complex, or commercial/industrial development shall be in parking lots, private drives, or similar open areas that will permit an unobstructed vehicle access for maintenance by City forces.

604.02 MINIMUM COVER

604.02.A Storm drains shall be at a minimum depth of 4-feet or greater below the finish grade elevation. Minimum pipe depth shall be measured between the finished surface grade at the centerline of the storm drain and the top of storm drain pipe. Storm drains at depths less than this create problems with water line crossings, sewer lateral crossings, and proper cover over the pipe per manufacturer's recommendations. Fill may be required on development sites to maintain adequate cover over storm drain lines.

604.02.B In some extreme locations where flat terrain limits the extension of storm drains, the City Engineer may allow some pipeline configuration changes as well as alternate pipe cover depths in conjunction with site filling. Storm drain pipes with depths less than 4-feet, where allowed by the City Engineer, shall be connected from catch basin to catch basin in lieu of the use of manholes. Special pipe material such as ductile iron pipe or reinforced concrete pipe (down to 24-inches of cover) will be required.

604.02.C In areas of flat terrain, the Design Engineer shall show that sufficient depth is provided at the boundary of the development to properly drain the remainder of the upstream basin area tributary to the site or that other drainage options are available to the upstream property.

604.03 SEPARATION FROM WATERLINES

604.03.A Storm drain lines shall be installed a minimum clear distance of 5-foot horizontally from water mains and shall be installed to go under such waterlines with a minimum of 6-inch of vertical clearance at the crossing of these pipes. Exceptions shall be approved by the City Engineer. In all instances the distances shall be measured surface to surface.

604.04 ACCESS AND UTILITY EASEMENTS

604.04.A When, in the Design Engineer's opinion, it is impractical to locate storm drains in rights-of-way, the storm drain shall be placed in an easement, as approved by City Engineer. Public utility easements granted to the City shall be perpetual easements and shall conform to the requirements of Section 102.08, except as noted below.

1. Open channels shall have easements sufficient in width to cover the 100-year floodplain line when a 100-year design storm is required, or 15-feet from the waterway centerline, or 10-feet from the top of the recognized bank. In addition, a 15-foot wide access easement shall be provided on both sides of the channel for channel widths greater than 14-feet at the top of the recognized bank.

605 STRUCTURES

605.01 MANHOLES

605.01.A GENERAL

1. Manholes shall be located at all changes in pipe slope, grade, alignment, size, type, and at all pipe junctions with present or future storm drain lines. A manhole shall be placed at the upstream end of each mainline, 7-feet maximum from property line to centerline of manhole.

2. Manhole spacing shall not exceed 450-feet. Deviation from this standard will be considered based on whether or not flushing, cleaning, and CCTV inspection equipment can adequately service the proposed spacing.

3. For ease of maintenance and inspection, manholes shall be installed within the right-of-way of paved public streets. If a manhole must be located outside of the public street right-of-way, access to the manhole shall be provided by means of an easement having a width consistent with Section 102.08. The easement shall be complete with an all-weather driveable surface from the adjacent public street to the manhole. The driveable surface shall extend to a point at least 10-feet beyond the manhole for equipment access.

4. Where practical, manholes shall be located at street intersections and shall be located outside the normal wheel travel lanes. Manhole lids are not permitted within designated existing or future bike lanes. Manholes shall not be placed in curbs or gutters or behind curbs. Manhole lids shall have a minimum of 12-inches of clearance from the edge of a curb and gutter.

5. Manholes located in unimproved areas shall have their lids positioned approximately 1-foot above the surrounding grade and be marked with City approved metal marker post. Manholes located in backyards, side lots, or otherwise substantially outside of the traveled right-of-way, may require tamperproof, locking lids. For public lines in easements within parking lots or other similar traveled areas, locking lids will generally not be required. In all areas prone to ponding, flooding, or along stream corridors, and in all areas below the 100-year flood plain, waterproof covers shall be installed. These types of manhole locations should be avoided whenever feasible and practical. Non-standard locations will require review by the City on a case-by-case basis.

6. Two manholes shall be provided for locations where the horizontal angle between the outgoing storm drain and the incoming storm drain will be less than 90 degrees. This is intended to prevent stormwater from discharging into the oncoming flow of an opposing storm drain.

7. Where internal system overflows may occur and covers are intended to prevent such overflows, the manhole cone and cover shall be designed to resist the resulting hydrostatic forces and be provided with vent piping. Vent piping configuration and cone and cover restraint will be reviewed by the City on a case-by-case basis.

8. Tee connections in storm lines will not be allowed (with the exception of private service lateral connections), unless otherwise approved by the City Engineer. Private connections to the public system will be reviewed on a case-by-case basis.

9. Standard inlets will not be allowed in lieu of manholes in any system.

605.01.B DROP THROUGH MANHOLES

1. Standards for elevation differences at manholes have been established to compensate for normal energy losses and to prevent surcharging of the storm drain system. For purposes of slope calculation and for establishing elevation differences, the elevations are given at the theoretical horizontal intersection of the storm drain centerlines (usually the center of the manhole). The rules for elevation differences at manholes are:

a. Where the pipe size decreases upstream through the manhole, the upstream pipe crown shall match the elevation of the crown of the downstream pipe. Where grade is limited, matching 0.8 of the pipe diameters may be used. If the incoming and outgoing pipes are of equal size and are passing straight through the manhole, the invert elevation difference shall be at least 0.10-feet. Manhole channels shall meet the requirements of the Standard Construction Specifications.

b. If the pipe alignment changes at the manhole, the invert elevation difference shall be at least 0.10-feet for 0 to 45 degrees of horizontal deflection angle, and 0.20-feet for 45 to 90 degrees of horizontal deflection angle. Horizontal deflection angles of greater than 90 degrees are not allowed. New piping, which is to be connected to existing manholes, shall generally adhere to these same hydraulic considerations. Existing concrete channels within the manhole shall be modified accordingly.

c. Pipes entering manholes may have a maximum free fall of 3-feet as measured to the invert of the manhole base, unless otherwise approved by the City Engineer. Larger pipelines shall be introduced into the manhole at the manhole invert.

2. Connections must enter the manhole through a channel in the base. This includes drop connections and connections to existing manholes.

605.01.C MANHOLE STANDARD DRAWINGS

1. All manholes shall have a minimum inside diameter of 48-inches and shall be in compliance with the Standard Construction Specifications. Manhole to piping connections shall be made with watertight, flexible manhole/pipe rubber connectors, as shown in the Standard Drawings.

2. The manhole Standard Drawings are suitable for most conditions. New designs or revisions should not be shown on the construction plans unless the Standard Drawings are not suitable. New or revised designs may be necessary if:

   - One or more of the sewers to be connected to the manhole is over 27-inches in diameter. (smaller diameters may require a special design if the manhole is at an alignment change)
   - Several sewers will be connected to the manhole.
   - There is less than 90 degrees between the incoming and outgoing sewer.
   - The manhole will be subject to unusual structural loads.
   - Diversion or other flow control measures are required.

3. If a special design is required for any reason, it will be necessary to show that design on the construction plans and to provide the City Engineer with structural calculations if so requested.

4. Some alternate manhole features are shown in the Standard Drawings. Where these features are required, they shall be specified by a note on the construction plans. Some examples are:

   - Slab tops shall be used in lieu of cones where there will be less than 5-feet between the invert of the outlet pipe and the top of the manhole lid.
   - Watertight manhole frames and covers shall be used if floodwaters are expected to cover the manhole top or if the manhole must be located in the street gutter. Such conditions should be avoided wherever feasible.
   - Tamperproof manhole frames and covers are required in all areas outside the paved public right-of-way.

605.02 INLET MANHOLES

605.02.A Where stormwater systems connect to the existing or proposed public stormwater system at an inlet location, inlet manholes will be required where any of the following apply, unless otherwise approved by the City Engineer:

- The pipe connection is larger than 6-inches in diameter.
- Two (2) or more pipes discharge to the location.
- The design peak flow from the onsite system exceeds 0.5 cfs.

605.02.B The inlet manhole shall be designed in accordance with the most current edition of the following:

- Hydraulic Engineering Circular No. 22 (FHWA-TS-84-202) Drainage of Highway Pavements.

605.03 INLETS (SIDE-INLET CATCH BASIN AND CURB INLETS)

605.03.A Inlets may be connected together (maximum of three (3) inlets) at intersections to minimize the number of pipe crossings of the streets and number of manhole penetrations required. Inlet piping shall be connected to the storm drain system at manholes.

605.03.B Inlets shall be spaced to assure that the flow in the streets can be intercepted and no ponding in the street occurs during the design storm. However, the maximum total length of curb and gutter that may be drained by a curb inlet is 400-feet.

605.03.C The width of gutter flow on all street classifications shall not exceed 8-feet from face of curb or 3-inches in depth measured at the curb face for a 10-year design storm at any point along the street. Inlets shall be designed to completely intercept the 10-year design storm gutter flow. However, sag vertical curves in major collectors and arterials shall be designed to intercept the 50-year design storm. The 100-year design storm shall be evaluated, and provisions shall be provided, at all locations where ponding to hazardous depths are likely to occur.

605.03.D Inlet locations shall be coordinated with other design features such as sags, driveways, crossroad intersections, pedestrian crosswalks and handicap ramps, and interception points for concentrated flow from sources outside the pavement. Inlets shall not be placed in locations that may be objectionable to residents or interfere with other construction elements along the street. Avoid inlets directly in front of store fronts or pedestrian handicap ramps. Exceptions will be considered on a case-by-case basis.

605.03.E Inlets shall be located at the following locations, but in no case be spaced further than 400-feet:

- At curb returns on the upstream side of an intersection.
- At the ends of all dead-end streets with a descending grade (both gutters).
- At intermediate locations so that 10-year storm flows at the curb line do not exceed 8-feet in width (measured from the curb face) or 3-inches in depth (measured at the curb face), whichever is less.
- At the upstream end of the street improvements that abut unimproved roads or undeveloped property.
- At the downstream end of the street improvements that abut unimproved roads or undeveloped property.
- At superelevation transitions, 10 feet before the point where the street cross slope begins to super-elevate toward the opposite side to prevent cross street flow.
- As required by the City Engineer.

605.03.F Two inlets, or a single unit double inlet, are required at low point (sag) of all vertical curves, unless otherwise approved by the City Engineer.

605.03.G Runoff from side drainage, such as parking lots, usually enters the street at a specific location. An inlet shall be placed downstream of this point when gutter capacity is inadequate. If there are ditches behind the curb and gutter, area inlets shall be provided in the ditch to intercept flows from offsite.

605.03.H After the project inlets have been preliminarily placed in the proposed plan, the Design Engineer shall perform a complete inlet spacing analysis. The analysis begins at the upper most inlet in the drainage basin and the quantity of flow in the street is calculated. This calculated runoff is the sum of the street runoff and side drainage runoff reaching the inlet. The inlet is then moved uphill or downhill, changing the drainage area until the computed runoff equals the street capacity within allowable water spread width. As a rule of thumb, about 70 to 80 percent of the design flow is intercepted. Only part of the flow bypassing an inlet is added to the total for the next inlet, with a rule of thumb being that only up to 50 percent of the bypass flow should be taken to the next inlet.

605.03.I Inlets shall be designed in accordance with the most current edition of the following:

- ❖ Hydraulic Engineering Circular No. 22 (FHWA-TS-84-202) Drainage of Highway Pavements.

605.04 SURFACE DRAINAGE INTERCEPTION (DITCH INLETS AND AREA DRAINS)

605.04.A Ditch inlets or area drains shall be provided wherever a surface drainage (creek, ditch, swale, or ponding areas) is intercepted and placed into a piped system. The ditch inlet or area drain shall be concrete and shall have removable grating covering the inlet. See Standard Drawings. The ditch inlet grate shall have the bars oriented in the vertical direction.

605.04.B The invert of the ditch inlet or area drain shall be at or below the invert of the drainage being intercepted. The inlet shall be designed to accommodate the anticipated peak flows of the surface drainage at the design storm.

605.04.C Special attention shall be paid to where water will accumulate and flow, should the inlet become clogged or blocked. In sensitive areas, accommodations for overflows caused by inlet clogging shall be made such that the overflow does not damage downstream areas.

605.05 SLOPE INTERCEPT DRAINS

605.05.A Slope intercept drains shall be provided at the following locations:

1. Along the upper boundaries of a development where the natural ground slope exceeds 10 percent to intercept drainage from the tributary area above the site.

2. Along the lower boundary of a development where the natural ground slope exceeds 10 percent to prevent drainage onto a lower tributary area other than by means of an approved point of disposal.

3. Along the top of all cuts that exceed 4-feet with cut slopes that exceed 2:1 where the tributary drainage area above the cut slopes towards the cut and has a drainage path greater than 40-feet, measured horizontally.

605.06 SUBSURFACE DRAINAGE INTERCEPTION

605.06.A Subsurface drains (underdrains) shall be provided at the following locations:

1. Cut and fill slopes in excess of 4-feet for stability, except when a soils report submitted by a registered professional engineer experienced in soils certifies they are not required.

2. Existing springs or springs intercepted during construction activity for other facilities, i.e., sewer, water mains, or street excavations.

3. Where high ground water exists or when it is necessary to reduce the piezometric surface to an acceptable level to prevent land slippage or underfloor flooding of buildings.

605.06.B The drainage line installed shall begin at a cleanout and terminate at an approved point of discharge. Open-jointed storm drain lines will not be considered as an acceptable solution.

605.07 OUTFALLS TO SURFACE DRAINAGE CHANNELS

605.07.A GENERAL

1. Storm drain lines shall enter a creek or drainage channel at 90 degrees or less to the direction of flow. The outfall shall have a head wall and scour pad or rock protection to prevent erosion of the existing bank or channel bottom in accordance with Subsection 605.08 and as approved by the City Engineer. Outfall structures for pipes of 24-inches in diameter or greater shall have grating covering the outlet. The grate shall have the bars oriented in the vertical direction. Outfall grates shall be attached to the outlet structure with a hinged connection at the top of the grate.

2. The outfall shall not intrude into the channel and reduce flow capacity of the channel. Pipe ends shall be beveled to match the side slope of the channel. Energy dissipation measures and armament of the opposite channel bank are required at the outfall. The size of the receiving facility will govern what protective measures are required. Backflow valves may be required on outfall structures to prevent backwater from surcharging and flooding the new storm drain improvements.

3. Outfall rock protective measures shall conform to the requirements of Section 605.08.

605.07.B STEEP SLOPES

1. Outfalls proposed on slopes greater than 15 percent or greater than 20-feet in height must meet one of the following criteria:

   a. The discharge must be less than 0.5 cfs.

   b. A tight-line conveyance system shall be constructed to convey the runoff to the bottom of the slope with adequate energy dissipation at the bottom to protect the toe of the slope and/or the receiving watercourse from erosion.

605.08 OUTFALLS AND BANK PROTECTION

605.08.A The outfalls of all stormwater systems shall be adequately protected to prevent erosion of slopes and channels. All outfalls shall include, at a minimum, the rock protection as shown in the table below and shall be designed in accordance with the ODOT Hydraulics Manual. Alternative approaches to protection may be accepted, as approved by the City Engineer.

ROCK PROTECTION AT OUTFALLS

Velocity at Design Flow (fps)	REQUIRED PROTECTION MINIMUM DIMENSIONS				
	Type	Thickness	Width	Length	Height
0 to 5	ODOT Class 50** Riprap	2 x max stone dia., 1.5 ft min.	Dia. + 6 ft or 3 x dia., whichever is greater	8 ft or 4 x dia., whichever is greater	crown + 1 ft or 1 ft above the design water surface elevation, whichever is greater
5 to 10	ODOT Class 200** Riprap	2 x max stone dia., 2.5 ft min.		12 ft or 4 x dia., whichever is greater	
10 to 20	Designed System*	As required	As required	As required	
Greater than 20	Energy Dissipater Required				

** For high velocity outfalls, engineering calculation are to be submitted to the City for review.*
*** ODOT Riprap Class in English Units*
**** For high velocity channels, engineering calculations are to be submitted to the City for review*

606 SURFACE DRAINAGE

606.01 SURFACE DRAINAGE

606.01.A For purposes of these Design Standards, surface drainage routes will be classified according to two general categories: constructed watercourses and natural creeks.

1. Plan requirements for surface drainage courses shall include the requirements previously specified in Subsection 602.02 and the following supporting data and calculations:

   a. Profile of the channel showing the existing flowline and top of bank, proposed flowline and top of bank, and design water surface profile (backwater curve).

   b. A minimum of three (3) cross sections of the existing channel adjoining or crossing the property taken at the upstream, midsection, and downstream boundaries of the property. More sections may be required depending on the length of the reach and existing channel alignment.

   c. Calculations for arriving at the design flow rate: the City will furnish the flow rate when records are available. Analyze the proposed system and show that the channel cross section after improvement will pass the design storm with 1-foot of freeboard to the top of bank. For channels shown on the F.I.R.M. maps, show that the channel cross section after improvement will pass the base flood at or below the 100-year flood elevation shown on the F.I.R.M.

d. Rights-of-way sufficient in width shall be provided to cover the 100-year Floodplain Line when a 100-year design storm is required or 15-feet from the top of the recognized bank, whichever is greater.

606.02 CONSTRUCTED WATERCOURSE REQUIREMENTS

1. Constructed watercourses shall be designed with a "natural" curved alignment with a variable side slope not to exceed four to one, except that in tight spots created by existing natural features (e.g., boulders, large trees, etc.) where the slope can be three to one until the natural feature is bypassed or where steeper slopes are needed and do not impair the hydraulic efficiency of the waterway. The watercourse shall include a low flow channel as described below and will be reviewed on a case-by-case basis for approval.

2. The bank shall be designed with 1-foot of freeboard above the design storm with a minimum top of bank width of 6-feet. A larger width shall be provided when required by the City Engineer for maintenance purposes. The backslope of the bank shall not exceed two (2) horizontal to one (1) vertical. The existing ground adjacent to the toe of the bank backslope shall be graded to slope away at 2 percent to prevent water ponding at the backslope toe.

3. Design shall be curvilinear with a 100-foot minimum radius. Tighter curves may be used if the City Engineer determines that sufficient erosion control has been incorporated into the design to maintain stable bank conditions following development.

4. A low flow channel shall be designed to carry a 2-year design storm or the normal low water flow of a year-round creek, whichever is greater. Low flow channel slopes shall not exceed two (2) to one (1) and shall be stabilized to the satisfaction of the City Engineer. In general, bank stabilization will be required in any channel with a design flow velocity in excess of 3-feet per second.

5. Capacity of channels shall be determined by the Manning Formula. The value for "n" shall be 0.033 for maintained grass-lined swales. The value for "n" shall be 0.035 for channels with rock-lined bottoms.

6. Existing ditches approved for the point of discharge for storm drains and culverts shall be provided with rock-lined bottoms and side slopes at the discharge point of storm drain or culvert. The rock shall extend for a minimum distance of eight feet downstream from the end of the storm drain or culvert.

7. Channel sides and bottoms shall be seeded, sodded, or rock lined immediately following construction. Bank stabilization measures shall be designed and included in the construction plans.

8. Points of discharge from culverts and storm drains into ditches and swales 15 percent or greater in grade shall be rock lined with riprap. Riprap shall extend for a distance of 10-feet minimum from the point of culvert or storm drain discharge and shall have a width 3-feet in excess of the diameter of the culvert or storm drain. Special energy dissipaters may be substituted for riprap at the discretion of the City Engineer.

606.03 NATURAL CREEK REQUIREMENTS

606.03.A GENERAL

1. A permit shall be obtained from the Division of State Lands and the Department of Fish and Wildlife for all work between the creek banks.

606.03.B CREEK CLASSIFICATION

1. Creeks in Stayton are classified as salmon-producing creeks or other natural creeks. No in-stream work will be allowed in salmon producing creeks during the months of September or October. The intent is to minimize sediment production in these creeks during critical salmon spawning season.

606.03.C SALMON-PRODUCING CREEK REQUIREMENTS

1. In addition to the other natural creek requirements listed below, the following requirements shall be met in salmon-producing creeks. These are not in replacement of the requirements for natural creeks, but in addition to them.

    a. Creek bed alterations shall provide diversified habitats for a variety of creek organisms and a pleasing appearance. Creek bed alternations may be approved by the City Engineer on a case-by-case basis based on the following provisions:

        1) Sufficient water depth to support fish and other aquatic life during low flows.

        2) Diversity of water velocities through the use of pools and riffles.

        3) A meandering channel to facilitate 1) and 2) above.

        4) Sufficient creek bed gradient to provide adequate flow velocities.

    b. Creek bed gravel shall be well rounded rock in the following gradations (with larger rock in sufficient quantity to provide adequate riffling) or as approved by the City Engineer:

        1) Mill Creek – Approximately 15 percent, 3”-6”.

    c. Creek banks and sides shall be designed and constructed so as to provide stability, adequate shading, and cover for fish and other aquatic life, to the approval of the City Engineer. Shading shall be provided by plantings of appropriate types and sufficient quantities per these Design Standards. Creek bank designs and vegetation restoration plans may be approved by the City Engineer on a case-by-case basis.

    d. Vertical creek banks (walls) should be avoided whenever possible; as such a creek channel configuration decreases the creek carrying capacity and increases in-creek velocities during high flows (depending on bottom width provided).

    e. Creek work and channel design shall include a construction sequence list designed primarily to control erosion and also to facilitate the planned construction. The construction sequence may be modified by the City Engineer during the construction as field conditions warrant.

f. Vegetation disturbance shall be minimized and creek banks revegetated with appropriate native vegetation to provide shading for the creek.

g. Bank protection using large diameter rock (riprap) is not permitted by regulatory agencies and natural organic protection, such as root balls, log jams, and bio-engineered lining, shall be used. Regulatory agency approval of the design will be required.

606.03.D OTHER NATURAL CREEK REQUIREMENTS

1. Natural creeks shall be preserved and all work in and adjacent to creeks shall incorporate both temporary and permanent erosion control measures to protect disturbed areas from erosion and damage. No alteration will be permitted that reduces the overall creek capacity.

2. Creek channel design and construction practices shall be such that the cumulative incremental effects of creek work considered alone or together with existing or similar projects in the vicinity will not result in substantial damage to existing waterways and surface waters by erosion, siltation or sedimentation, significant changes in stormwater quality, increased downstream water velocity, significant harmful deterioration of groundwater drainage, or significant deterioration of aquatic wildlife habitat as determined by the City Engineer.

3. Creek construction, relocation, and/or reconstruction may be approved if the City Engineer determines that such a proposal will result in an overall benefit to or maintenance of a surface water system of equal quality in terms of water quantity and quality control and the Developer can obtain the appropriate State and Federal permits.

4. Any and all stream work shall be consistent with the floodplain management policies and regulations and as set forth in Stayton Municipal Code or any amendments thereto.

   a. Any and all stream work shall be consistent with the Storm Water Master Plan.

606.04 CHANNEL PROTECTION

606.04.A Open channels shall be designed to prevent scouring of the channel. Use of riprap on any channel will be reviewed by the City Engineer on a case-by-case basis. Bio-engineering lining may be required. In addition, regulatory agency approval of the design may be required.

606.04.B Where rip rap protection is allowed and specified, rip rap protection shall be placed over a filter fabric base or a minimum 6-inch thick gravel base. The following provides additional design guidance in assisting the Design Engineer; however, the Design Engineer shall be responsible for the final design. Channel protection shall be designed in accordance with the ODOT Hydraulics Manual.

PROTECTION FOR NEW CHANNEL CONSTRUCTION				
Velocity At Design Flow (Fps)		Required Protection	Thickness	Minimum Height Above Design Water Surface
Greater Than	Less Than Or Equal To			
0	3	Vegetation Lining	N/A	0.5 ft
3	5	Vegetation Lining and Check Dams	N/A	0.5 ft
5	8	Bioengineered lining* or	N/A	1 ft
		ODOT Class 50** Riprap	1.5 ft	
8	12	Bioengineered lining* or	N/A	2 ft
		ODOT Class 200** Riprap	2.5 ft	
12	20	Slope Mattress, etc.***	varies	2 ft

** Bioengineered lining allowed for greater than 5 fps.*
*** ODOT Riprap Class in English Units*
**** For high velocity channels, engineering calculations are to be submitted to the City for review*

607 STORMWATER QUALITY FACILITIES

607.01 GENERAL

607.01.A Stormwater quality facility designs shall comply with the most current edition of the following design manual, except as specifically modified by these Design Standards.

1. City of Portland Stormwater Management Manual. The City of Portland Stormwater Management Manual provides guidance for selection and basic design considerations of stormwater quality facilities in the City of Stayton. The guidelines are not intended to be a comprehensive list of all stormwater facilities, but provides a general overview of those commonly used. In selecting the appropriate stormwater facility for a site the designer must consider the site characteristics, anticipated land uses, runoff characteristics, and treatment objectives. The use of any other resource shall be coordinated with the City Engineer prior to design.

607.01.B New development and other activities which create new impervious surfaces of greater than 3,000-square feet in area within any twelve (12) month period or increase the amount of stormwater runoff or pollution leaving the site are required to construct or fund permanent stormwater quality facilities to reduce contaminants entering the storm and surface water system.

607.01.C The purpose of stormwater quality facilities is to reduce the pollutants associated with stormwater runoff from new development and redevelopment. By establishing criteria, the City is satisfying federal regulatory requirements to control the discharge of pollutants into stormwater as specified in the Clean Water Act Amendments of 1987 and its National Pollutant Discharge Elimination System (NPDES) permit for discharges from a municipally owned and operated separate storm sewer system issued by the Oregon Department of Environmental Quality (DEQ) under authority of the United States Environmental Protection Agency (EPA).

607.01.D The requirements are minimum standards. If the City determines that additional controls are necessary in basins that drain to sensitive receiving waters or groundwater sources (such as defined by the DEQ's 303d, and proposed Total Maximum Daily Load (TMDL) requirements for water-quality limited streams, the DEQ's Underground Injection Control Regulations, or Federally designated threatened and endangered fish listings), additional facilities, treatments, or other best management practices (BMP's) may be required. These requirements could include larger facility designs as well as additional types of stormwater quality controls.

607.01.E It is the responsibility of the Developer(s) to meet stormwater treatment requirements for their particular development. While there have been significant advances in the field of stormwater treatment technologies, the stormwater quality program still requires a best effort attempt at installing facilities that will address the commonly predictable stormwater problems of a development. Therefore, it is essential that the Design Engineer consider the future use of a site and provide solutions for any predictable stormwater quality problems.

607.02 MINIMUM DESIGN CRITERIA

607.02.A The stormwater quality facilities shall be designed to remove 80 percent of the total suspended solids from the runoff from 100 percent of the newly constructed impervious surfaces.

607.02.B The total suspended solids removal efficiency specifies only the design requirements and is not intended as a basis for performance evaluation or compliance determination of the stormwater quality control facility installed or constructed pursuant to this document.

607.02.C If an onsite stormwater quality facility cannot be constructed to treat the runoff from the development's impervious surface, then with City approval, an on- or off-site stormwater quality facility may be designed to treat runoff from an equivalent area of adjacent untreated impervious surfaces.

607.02.D Facilities shall be designed such that flow from the development is treated off-line from the storm conveyance system and reconnected to upstream flows following treatment. If an off-line facility is not feasible, additional capacity may be required for upstream flow.

607.02.E Discharges to sensitive areas shall maintain the pre-development flow rate to the extent necessary to protect the characteristic functions of the sensitive area.

607.02.F Stormwater quality facilities shall be constructed as part of the public improvements.

607.02.G Stormwater quality facilities shall be designed to address the Willamette Basin TMDL pollutants of mercury, temperature, and bacteria.

607.02.H Other design options for meeting this section may be considered by the City for approval.

607.03 ON-SITE FACILITIES

607.03.A A stormwater quality facility shall be constructed on-site, unless otherwise approved by the City Engineer.

607.04 IMPERVIOUS AREAS

607.04.A For all developments, the sizing of stormwater quality facilities shall be based on the impervious area created by the development and for all existing impervious area proposed to remain on site, including but not limited to roofs, structures, roads, and other impervious areas. Impervious surfaces shall be determined based upon building permits, construction plans, or other appropriate methods of measurement deemed reliable by the City Engineer.

607.04.B The City encourages design initiatives that reduce effective impervious area. In developments other than single family and duplex, a decrease in the size of the stormwater quality facility may be possible.

607.05 OPERATION AND MAINTENANCE PLAN

607.05.A An operation and maintenance plan shall be submitted for City review and approval for all privately financed private stormwater quality facilities. The plan shall include types and frequencies of operation and maintenance activities.

607.05.B Operation and maintenance requirements for stormwater quality facilities shall comply with the most current edition of the following:

- City of Portland Stormwater Management Manual.

608 STORMWATER DETENTION FACILITIES

608.01 GENERAL

608.01.A Stormwater detention facilities shall be open basins or ponds. Underground detention systems (pipe/vault) may be used where approved by the City Engineer.

608.01.B Storm drainage runoff originating from and/or draining to any proposed development shall be controlled and/or conveyed in accordance with all City Standards and Policies as described in these Design Standards. When existing conditions make storm drainage detention impossible for a portion of a site, the City Engineer may permit compensatory storage volume to be provided on another portion of the site, provided the total site area is tributary to one drainage basin both prior to and after development. In no case shall the runoff rate from the total site exceed the allowable release rate.

608.01.C Under some specific situations, detention requirements may be waived and direct discharge may be allowed, as determined by the City Engineer. Direct discharge will not exclude the use of erosion control or other stormwater quality control techniques within the development. Waiver of the detention requirement may also be allowed along a channel that has been fully improved to accommodate the 100-year design storm.

608.01.D Unless directed otherwise, detention facilities will be required to detain post-developed runoff from the 5-year, 10-year, and 25-year 24-hour storm to pre-developed quantities. If the project area is greater than one-hundred (100) acres or covers multiple drainage sub-basins, such as for a regional detention facility, then the 50-year 24-hour storm must also be detained to pre-developed peak volumes. Potential downstream damage due to detention system failure/overflow may require greater detention requirements or improvements downstream. In no case shall the release rates increase the flooding conditions downstream.

608.01.E Detention facilities shall have emergency overflow (auxiliary outlet) provisions incorporated into their design. Flow capacity of the overflow shall be calculated and shown as supporting information. The emergency overflow must be designed to accommodate 100-year 24-hour storm flows.

608.01.F Drainage plans shall include a plan and profile of the facilities. The profile requirement for private drainage systems may be waived at the discretion of the City Engineer when sufficient data is provided on the plan in a clear and concise manner including the following minimum hydraulic and physical data:

- Grades, bottom elevations of ditches, channels, ponds and swales, parking lots and recharge trenches;
- Inverts of pipes;
- Inverts and tops of all structures such as manholes, catch basins, chambers, or similar structures; and
- Size, length, and slope of all pipes or other detention or conveyance facilities, including the invert elevations of the existing or any other storm drainage system that the subject drainage proposes to discharge into. The design volume of all detention ponds shall also be shown on the plan as well as a note indicating that ponds shall be inspected prior to landscaping.
- Proposed seeding, vegetative covering and landscaping.

608.01.G The on-site drainage system must be properly designed to handle all flows developed on-site and all flows that flow through the site from upstream. Designers should conceptualize how water will move into, through, and out of the system, looking for such potential problems as flow impediments, construction difficulties, future maintenance problems, and soil erosion potential.

608.01.H Public health, safety, maintenance, nuisance abatement, and vector control must be carefully reviewed in every drainage control system plan. Protective measures are often necessary and will be required whenever appropriate. The protective measures themselves shall be designed so as not to constitute hazards or nuisances.

608.01.I The impact of a system failure shall be analyzed both in terms of on-site and off-site effects. The impacts may be to adjacent properties, or to elements of the public drainage system or other private systems. The downstream consequences of failure of a detention pond shall be included in determining location and design parameters.

608.01.J The frequency and difficulty of future maintenance can be minimized by thorough consideration during design of what could possibly go wrong in the system and what would be required to correct the problem. Facility design shall incorporate maintenance considerations to ease such problems.

608.01.K The use of the site shall be evaluated to determine if hazardous materials or other pollutants are likely to be present, and if extraordinary design considerations are necessary. Construction of on-site detention will not be allowed if such a detention facility would have an adverse effect upon receiving waters in the basin or subbasin in the event of flooding, or would increase the likelihood or severity of flooding problems downstream of the site.

608.01.L The visual impact and other potential problems (mosquito breeding, smell, etc.) shall be minimized. Concerns will vary with the site environment, but aesthetics should always be of concern to the designer.

608.01.M It is important that runoff from rooftops pass through the detention system; the design shall clearly indicate how roof runoff moves through the system.

608.01.N The minimum allowable diameter for an orifice in a flow control structure shall be 2-inches due to the possibility of clogging or plugging.

608.01.O Access, passable by a maintenance vehicle, to all control structures by appropriate equipment shall be provided with easements dedicated to the City.

608.02 DETENTION PONDS

608.02.A GENERAL

1. Interior slopes of detention ponds shall not exceed 4-feet horizontal to 1-foot vertical (4H:1V) for all detention ponds in master planned developments, subdivisions, and land partitions. Ponds in commercial, industrial, and multifamily developments that are to remain under private ownership and maintenance shall have at least one interior slope not exceeding 4H:1V with all other interiors exceeding 4H:1V to be either retaining walls designed by a licensed structural engineer or a design submitted by a licensed engineer experienced in soils mechanics. Detention pond exterior slopes shall not exceed 2-feet horizontal to 1-foot vertical.

2. The maximum design water depth in all detention ponds shall be 4-feet. Ponds less than 3-feet shall have a minimum bottom dimension of 6-feet or as approved by the City Engineer. Ponds 3-feet to 4-feet deep shall have a minimum bottom dimension of 15-feet.

3. Ponds suited to multiple use are encouraged. Examples of multiple uses are sport courts, play areas, neighborhood parks, picnic areas, and athletic fields. Such ponds that will provide public access shall be designed with special attention to safety of the public during inundation of the pond. Side-slopes shall be very gradual to avoid the risk of someone slipping into the pond and not being able to walk out.

4. Ponds shall be landscaped so as to provide slope stability, water treatment, and pleasant appearance by utilizing sodding, seeding, and planting of trees and shrubbery. Under no circumstances will the use of easily floatable or erodible materials (such as "bark dust") be permitted in pond interiors.

5. Maintenance of surface ponds in commercial, industrial, and multifamily developments shall be the responsibility of the property owner(s) or owner's association. Maintenance of surface pond landscaping in single family residential areas and PUD developments shall be the responsibility of an owner's association or community club and shall be so stated on the face of the plat, unless otherwise accepted for maintenance by the City. Failure to maintain a weed abatement program will be cause for the City to perform the work and bill the owner or owners.

608.02.B STORMWATER QUALITY CONSIDERATIONS

1. The bottom of constructed and graded retention/detention ponds shall be sloped no flatter than 0.01 foot/foot (1 percent) towards the outlets for drainage. EXCEPTION: This requirement need not apply to natural ponds, which exist and are utilized for stormwater detention.

2. Detention ponds shall have a well-defined low flow channel to contain runoff of lesser storms. Low flow channels shall be designed so as to enhance the pond landscaping and overall pond appearance.

3. Outlets of detention ponds shall be provided with suitable debris barriers designed to protect the outlet from blockage or plugging. Properly-sized overflow structures shall be designed into the pond.

4. The inlet and outlet structures shall be on opposite ends of the pond to promote maximum residence time and to prevent short-circuiting. Baffles may be required to be installed to increase the residence time and flow path if locating outlet structures on opposite sides of the pond is not practical.

5. Detention ponds shall be designed so that the "drawdown" time does not exceed 48 hours. In the event drawdown time exceeds 48 hours, additional calculations shall be submitted showing the proposed facility can contain an additional 25-year, 24-hour return storm.

6. The use of a sedimentation fore-bay will be required during the construction process if the pond is to be used for sedimentation control. After construction is complete, the pond shall be completely cleaned and any sediment shall be removed prior to hook up to City infrastructure.

608.02.C OVERFLOW - EMERGENCY SPILLWAY

1. Detention ponds shall have a minimum of 1-foot of freeboard above the maximum design water surface.

2. A detention pond overflow system shall provide controlled discharge of the design storm event for developed contributing area without overtopping any part of the pond embankment or exceeding the capacity of the emergency spillway. The design shall provide controlled discharge directly into the downstream conveyance system. An emergency overflow spillway (auxiliary outlet) shall be provided to safely pass the 100-year, 24-hour design storm event over the pond embankment in the event of control structure failure and for storm/runoff events exceeding design. The spillway shall be located to direct overflows safely towards the downstream conveyance system. The emergency spillway shall be stabilized with riprap or other approved means and shall extend to the toe of each face of the berm embankment.

608.02.D ACCESS - MAINTENANCE

1. City-maintained detention pond control structures not abutting a public right-of-way shall be accessible to the City for maintenance and operation. Access roads and easements shall be provided to accommodate vehicular traffic year-round to both sides of the pond as necessary for vehicular maintenance access. Control structures shall be designed to operate automatically as much as possible.

2. A vehicular access shall be provided to the bottom of the detention pond when the bottom width of the pond is 20-feet or greater or when the height of the pond interior wall exceeds 5-feet.

3. Access roads shall meet the following criteria:

   - A maximum grade of 15 percent and a maximum cross slope of 3 percent.
   - A 40-foot minimum outside turning radius.
   - A minimum width of 15-feet.
   - Access roads in excess of 50-feet in length shall have a turn around.

- The capability of supporting a 20-ton vehicle under all weather conditions.

608.02.E BERM EMBANKMENT - SLOPE STABILIZATION

1. Any embankment for a detention pond with berms 4-feet in height or less (3-feet maximum water depth), forming one or more sides of a retention/detention pond shall have a minimum 10-foot wide top of berm with a back slope not to exceed three (3) horizontal to one (1) vertical, unless otherwise approved by the City Engineer. Pond embankment shall be designed and the construction certified by a professional Civil Engineer licensed in the State of Oregon.

2. Any embankment for a detention pond in excess of 4-feet must be designed by a professional Geotechnical Engineer licensed in the State of Oregon and approved by the City Engineer. The geotechnical engineer shall design, inspect, and certify the construction such that the pond and earth berms are safe for the intended use. Notes to the effect of the above shall be shown on the plans submitted for approval. The minimum top width of the berm shall be 15-feet, unless otherwise approved by the City Engineer.

3. The toe of the exterior slope of pond berm embankment shall be no closer than 5-feet from the tract or easement property line.

4. The pond berm embankment shall be constructed on native consolidated soil (or adequately compacted and stable fill soils analyzed by a geotechnical engineer) free of loose surface soil materials, roots and other organic debris.

5. The pond berm embankments shall be constructed by excavating a 'key' equal to 50 percent of the berm embankment cross-sectional height and width or as designed by a geotechnical engineer.

6. Anti-seepage collars shall be placed on pipes in berm embankments which impound water greater than 3-feet in depth at the design water surface.

7. Exposed earth on the pond bottom and side slopes shall be seeded with seed mixture approved by the City Engineer.

608.02.F DETENTION POND VOLUME

1. The design volume of the detention pond shall be shown on the plan and the pond volume inspected prior to landscaping (a note to this effect shall be shown on the plans).

2. The detention pond shall be designed in accordance with the most current edition of the following:

   - City of Portland Stormwater Management Manual.

608.02.G USE OF PARKING LOTS FOR DETENTION

1. Parking lots may be used to provide additional detention volume for runoff events greater than the two (2) year runoff event provided that:
    - ❖ The depth of water detained shall not exceed one (1) foot at any location in the parking lot for runoff events up to and including the 100-year event, AND
    - ❖ The gradient of the parking lot area subject to ponding shall be one (1) percent or greater, AND
    - ❖ The emergency overflow path shall be identified and noted on the engineering plan, and comply with all other development and drainage requirements, AND
    - ❖ Fire lanes used for emergency equipment shall be free of ponding water for all runoff events up to and including the 100-year event, AND
    - ❖ Parking lot utilities and facilities are note affected.

608.02.H USE OF ROOFS FOR DETENTION

1. Detention ponding on roofs of structures may not be used to meet flow control requirements.

608.03 UNDERGROUND DETENTION FACILITIES

608.03.A GENERAL

1. City preference is to have stormwater runoff detention occur above ground. In select locations, the City may approve the use of underground detention facilities. Underground detention facilities may only be proposed once all other means of surface detention have been explored and exhausted, and are subject to the approval of the City Engineer. Underground detention facilities shall be designed by a professional Civil Engineer licensed in the state of Oregon, and shall only be used as a means of controlling stormwater quantity. Stormwater quality treatment measures by utilizing manufactured treatment devices may only be used when specifically approved by the City Engineer.

2. To minimize the occurrence of routine maintenance, all underground detention facilities shall be designed with a stormwater quality manhole (or equivalent) upstream, to facilitate sediment fallout prior to stormwater entering the detention facility. Incoming velocities shall be reviewed as to reduce the potential for sediment washout.

608.03.B FREEBOARD

1. Underground detention facilities shall be designed to provide adequate freeboard. Freeboard is measured as the vertical distance between the water surface and the rim of the auxiliary outlet or the inside top of the detention pipe or detention vault.

2. The following freeboard shall be provided:
    - ❖ DESIGN STORM – 6 inches from design storm high water elevation to the auxiliary outlet rim elevation (i.e. overflow riser pipe). The freeboard criteria apply to the highest intensity storm if there are multiple design storms.

- ❖ 100-YEAR STORM – 6 inches from the 100-year storm (check storm) high water elevation to the inside top of the detention facility. The water surface elevation for the 100-year storm freeboard calculations is based on the entire flow passing through the auxiliary outlet (i.e. overflow riser pipe) and no flow through the primary outlet (i.e. orifice(s)).

3. The detention facility should have adequate venting to prevent pressure or vacuum as the water surface level rises or falls within the facility. This can be accomplished by having vented access cover over the facility or by connecting the top of the facility to a ventilated area with a pipe having a minimum diameter of 2 inches.

608.03.C DETENTION PIPE SYSTEMS

1. GENERAL

   a. Detention pipes serve as runoff quantity control through the means of underground storage. In addition to runoff quantity control, detention pipes shall be designed for factors such as environmental conditions (soil corrosivity, inundation, etc.), maintenance access, and ground and/or surface loadings.

   b. The minimum pipe size allowed for a detention pipe in the public drainage system shall be 36-inches in diameter.

   c. Detention pipes shall be designed as flow-through systems, incorporating the use of in line manholes for maintenance and sediment removal.

   d. Detention pipe bottoms shall be set at a grade of 0.005-feet per foot.

   e. City owned detention pipes shall be located in the right-of-way; detention pipes proposed to be located outside the public right-of-way shall be located in a public easement, dedicated to the City.

   f. The outlet flow control structure and detention pipe shall comply with the Standard Drawings, unless otherwise approved by the City Engineer.

   g. The closed detention pipe system is to be designed in accordance with the most current edition of the following:

      - ❖ ODOT Hydraulics Manual, Chapter 12 – Storage Facilities.

2. MATERIALS

   a. Acceptable materials for City owned detention pipes in public rights-of-way or public easements are:

      - ❖ Reinforced concrete pipe.
      - ❖ Solid wall HDPE.

   b. The following materials may be used for private systems located outside of public rights-of-way or public easements:

      - ❖ Reinforced concrete pipe.
      - ❖ Solid wall HDPE.
      - ❖ Corrugated exterior-smooth interior HDPE.
      - ❖ PVC pipe.

3. BUOYANCY

   a. The effects of buoyancy shall be considered in areas with a known high groundwater table, or areas where seasonal high groundwater may cause flotation of the detention pipe.

   b. Measures such as concrete anchors, concrete backfill, subsurface drains, etc. shall be required in these areas, as well as supporting engineered calculations.

4. STRUCTURAL STABILITY

   a. Special consideration shall be given to ensure pipes meet requirements for potential traffic loading and overburden support. Access and structural end-cap bracing specifications from the manufacturer are required. Pipes shall be placed on stable, well consolidated native material or engineered fill with appropriate bedding. A structural analysis, geotechnical analysis, and engineered calculations may be required with the design, demonstrating stability and constructability. For pipes proposed under the traveled way, H20 live loadings shall be accommodated.

5. ACCESS MAINTENANCE

   a. Access easements and roads shall be provided when pipes are not located within the public right-of-way.

   b. Access openings shall be provided at a distance of no less than 100 feet from any location within the pipe, shall be a minimum of 36 inches in diameter, and shall have water-tight round lids. Additionally, access openings shall be located at both the inlet and outlet locations of the detention pipe. Improvements shall be made to facilitate maintenance equipment access to the maintenance access points year-round. Maintenance access point shall not be in areas that can be fenced off by private property owners.

   c. Access openings shall have surface access for maintenance vehicles.

   d. The distance from pipe invert to finished grade shall be not more than 20 feet.

   e. OSHA confined space requirements shall be met for pipes, and entrances to confined spaces shall be clearly marked.

6. ACCESS ROADS

   a. Access roads shall meet the requirements set forth in Section 608.02.D above.

608.03.D DETENTION VAULTS

1. GENERAL

   a. Detention vaults serve as runoff quantity control through the means of underground storage. Besides runoff quantity control, vaults shall be designed for considerations such as environmental conditions (soil corrositivity, inundation, etc.), maintenance access, and ground and/or surface loadings.

   b. Detention vaults shall be a box-shaped design constructed with reinforced concrete.

   c. Detention vaults shall be designed as flow-through systems with level bottoms.

d. Ventilation pipes (minimum 1 foot diameter or equivalent) should be provided in all four corners of vaults to allow for ventilation for maintenance personnel. This is not required if removable panels are provided over the entire vault.

e. City owned detention vaults shall be located in the right-of-way; detention vaults proposed to be located outside the right-of-way shall be located in a Public Utility Easement, dedicated to the City.

f. Detention vaults are to be designed in accordance with the most current edition of the following:

- ODOT Hydraulics Manual, Chapter 12 – Storage Facilities.

2. MATERIALS

a. Detention vaults shall consist of minimum 3,300 psi structural reinforced concrete. Joints shall be constructed with water stops.

3. BUOYANCY

a. The effects of buoyancy shall be considered in areas with a known high groundwater table, or areas where seasonal high groundwater may cause flotation of the detention vaults.

b. Measures such as concrete anchors, concrete backfill, subsurface drains, etc. shall be required in these areas, as well as supporting engineering calculations.

4. STRUCTURAL STABILITY

a. Special consideration shall be given to ensure vaults meet requirements for potential traffic loading and overburden support. Vaults shall be placed on stable, well consolidated native material or engineered fill with appropriate bedding. A structural analysis, geotechnical analysis, and engineering calculations may be required with the design, demonstrating stability and constructability. For vaults proposed under the traveled way, H-20 live loadings shall be accommodated.

5. ACCESS MAINTENANCE

a. Access easements and roads shall be provided when vaults are not located within the public right-of-way.

b. Access openings shall be provided at a distance of no less than 50 feet from any location within the vault, shall be a minimum of 36 inches in diameter, and shall have water-tight round lids. Additionally, access openings shall be located at both the inlet and outlet locations of the detention vault. Improvements shall be made to facilitate maintenance equipment access to the maintenance access points year-round. Maintenance access point shall not be in areas that can be fenced off by private property owners.

c. Access openings shall have surface access for maintenance vehicles.

d. The distance from vault invert to finished grade shall be not more than 20 feet.

e. OSHA confined space requirements shall be met for vaults, and entrances to confined spaces shall be clearly marked.

6. ACCESS ROADS

   a. Access roads shall meet the requirements set forth in Section 608.02.D above.

608.04 OUTLET FLOW CONTROL STRUCTURES

608.04.A See Standard Drawings for typical outlet flow control structure.

608.04.B Primary (orifice(s)) and auxiliary (overflow riser pipe) outlets within the outlet flow control structure shall be designed in accordance with the most current edition of the following:

- ODOT Hydraulics Manual, Chapter 12 – Storage Facilities.

608.05 RIGHT-OF-WAY / EASEMENTS

608.05.A Detention facilities in plats may be required to be located in separate tracts dedicated to the City with access easements for maintenance where required. The minimum tracts and access easement widths shall be 15-feet.

608.05.B Where a detention facility is located within the boundaries of a commercial lot and not in a separate dedicated tract, the peak design discharge water surface shall be shown as an easement on the final plat hard copy. Restrictions shall be added to the final plat hard copy and appear on the face of the plat.

608.05.C A written restriction shall be added to the final plat hard copy to the affect that approval shall be obtained from the City Engineer before any structures, fill, or obstructions (including fences) are located within any drainage easement or delineated 100-year flood plain area.

608.05.D A drainage easement shall be required for all public, closed storm drainage detention systems. The City Engineer may require wider easements where pipe diameter or vault widths exceed 4-feet.

608.05.E All publicly maintained storm drainage systems including collection, conveyance, and flow restrictors not located in right-of-way shall be located in drainage easement or tract dedicated to the City.

608.05.F Permanent access and drainage easements shall be granted to the City for any storm drainage detention facility, which is located in a development, and for an access road to that facility where said facility and access road are located on property other than the development but serve the development. Access roads shall provide all-weather access. The owner in fee simple and contract purchaser of the property upon which the access road and facility are to be located shall execute the said easement.

608.06 INFILTRATION FACILITIES

608.06.A OVERVIEW

1. In general, infiltration facilities are used in areas of highly permeable soils to reduce the quantity of stormwater runoff in receiving systems and to recharge the groundwater aquifer. Examples of infiltration facilities include retention ponds, infiltration trenches, infiltration tanks, and drywells, among others. A geotechnical evaluation of the site, prepared by a geotechnical Engineer or licensed Geologist shall be required for infiltration facilities other than single lot residential drywells, proposed within the City and it's associated Urban Growth Boundary.

608.06.B UNDERGROUND INJECTION CONTROL (UIC)

1. The Oregon Department of Environmental Quality (DEQ) regulates and registers certain infiltration facilities as injection wells. Registration covers all injection wells, including stormwater drainage wells, industrial/commercial injection facilities, aquifer recharge wells, subsidence control wells, aquifer remediation wells, and other miscellaneous injection wells. In Oregon, all fresh water aquifers are protected as underground sources of drinking water.

2. In addition to the minimum Federal UIC requirements, all injection facilities shall further comply with Oregon Administrative Rule 340-44. Use of groundwater recharge from stormwater shall comply with DEQ requirements.

608.07 OPERATION AND MAINTENANCE

608.07.A An operation and maintenance plan shall be submitted for City review and approval for all privately financed private detention facilities. The plan shall include types and frequencies of operation and maintenance activities.

608.07.B Operation and maintenance requirements for detention systems shall comply with the most current edition of the following:

- ❖ City of Portland Stormwater Management Manual.

609 PRIVATE STORM DRAIN SYSTEMS

609.01.A Private storm drain systems that convey water directly from private property shall be 3-inches in diameter for drains under sidewalks and through curbs.

609.01.B Private storm drain systems will not be permitted within the public right-of-way, unless otherwise approved by the City Engineer. Where approved, private storm drain lines shall be a minimum of 6-inches in diameter and directly connected into a drainage structure of the public system at a location and elevation approved by the City Engineer.

609.01.C Easements for private storm drain systems are the responsibility of the property owners; but copies of the recorded easements must be given to the City prior to any construction.

609.01.D Private storm drain systems shall be installed on private property in accordance with the requirements of the State of Oregon Plumbing Specialty Code.

609.01.E Storm drainage associated with private streets shall conform to City public works standards.

610 EROSION AND SEDIMENT CONTROL MEASURES

610.01 GENERAL

610.01.A APPLICATION AND PURPOSE

1. It is a City requirement to reduce the amount of sediment and other pollutants reaching the public storm and surface water system resulting from development, construction, grading, excavating, clearing, and any other activity that accelerates erosion, to the limits prescribed in these Standards.

2. It is the policy of the City to require temporary and permanent measures for all construction projects to lessen the adverse effects of construction on the environment. Projects shall include properly installed, operated, and maintained temporary and permanent erosion-control measures as provided in these Standards or in an approved plan, designed to protect the environment during the term of the project. Compliance with the measures prescribed herein or in an approved plan does not lessen the necessity to provide effective and comprehensive erosion prevention and sediment control.

610.01.B PERMIT REQUIREMENTS

1. Construction projects with ground disturbance of one (1) or more acres will require a National Pollutant Discharge Elimination System Stormwater Construction General Permit No. 1200-C, as required by the Oregon Department of Environmental Quality. The City does not administer the State's 1200-C permit program. Evidence of a 1200-C permit shall be submitted to the City prior to final plan review approval and prior to any ground-disturbing activities.

2. In addition, an erosion and sediment control plan may be required to be submitted to the City for any ground-disturbing activity that requires a City building, public works, or development permit.

3. Sites that require an Oregon DEQ 1200-C permit are encouraged to submit the same erosion and sediment control plan for both the 1200-C permit and the City building, public works, or development permit.

610.01.C EROSION PROHIBITED

1. Visible or measurable erosion that enters, or is likely to enter, the public or private stormwater and surface water system or other properties is hereby prohibited, and is a violation of these Standards. An offsite sedimentation control facility may be utilized if it has been identified and approved in writing by the City Engineer, written approval is obtained from the respective property owner, and a written agreement for rehabilitation of the facility by the applicant or contractor is submitted to the City. The owner of the property or the applicant under a Public Works Permit, together with any person or persons, including but not limited to the Contractor or the Design Engineer causing such erosion, shall be held responsible for violation of the City's Standards.

2. No person shall create physical erosion by dragging, dropping, tracking, or otherwise placing or depositing, or permitting to be deposited, mud, dirt, rock, or other such debris on a public street, or into any part of the public stormwater and surface water system, or into any part of a private stormwater and surface water system that drains or connects to the public stormwater and surface water system. Any such deposited material shall be immediately removed by hand labor or mechanical means. No material shall be washed or flushed into any part of the stormwater and surface water system until all mechanical means to remove the debris are exhausted and preventive sediment filtration is in place.

3. The owner of the property or the applicant under a Public Works Permit, together with any person or persons, including but not limited to the contractor or the design engineer who causes such erosion, shall be held responsible for violation of these Standards.

4. The following minimum provisions are required for all ground-disturbing activities:

   a. Install measures intended to keep soil on site or out of water bodies, storm drainage systems or the public right-of-way as the first step in any development. These measures shall be made functional prior to any upslope development taking place.

b. Remove any soil that enters the public right-of-way.

c. Protect stormwater inlets that are functioning during the course of the development by approved sediment control measures so that sediment-laden water cannot enter the inlets without first being filtered.

d. Apply permanent or temporary soil stabilization to denuded development site areas in conformance with the following schedule:

- ❖ Between October 1 and April 30, all denuded sites shall be provided with either temporary or permanent soil stabilization as soon as practicable, but in no case more than 2 days after ground-disturbing activity occurs.
- ❖ Between May 1 and September 30, temporary erosion and sediment control measures to reduce dust and sediment transport shall be applied as soon as practicable, but in no case more than seven days after ground-disturbing activity occurs.
- ❖ Groundcover shall be installed on any portion of a site that is denuded for more than six months. Sports fields or playgrounds surrounded by vegetative cover or permanently installed curbing are exempt from this requirement.
- ❖ Temporary measures shall be maintained until permanent measures are established.
- ❖ Plant appropriate non-invasive replacement vegetative cover.
- ❖ Secure or protect soil stockpiles throughout the project with temporary or permanent soil stabilization measures. The responsible party is accountable for the protection of all stockpiles on the site, and those transported from the site. Depositions of soil may be subject to additional regulations requiring permit, review or erosion and sediment control.
- ❖ Select appropriate BMPs from the Standard Drawings and the ODOT Erosion Control Manual.

5. Existing vegetation shall be protected and left in place whenever practicable. Work areas shall be carefully located and marked to reduce potential damage to trees and existing vegetation. Trees shall not be used as anchors for stabilizing working equipment. Where required, trees and existing vegetation shall be protected with a non-movable, chain link fence.

6. Where existing vegetation has been removed, or the original land contours have been disturbed, the site shall be revegetated, and the vegetation established, as soon as practicable.

610.01.D ENFORCEMENT

1. Failure to comply with any provision of this Section or with any term of a permit shall be deemed a violation and subject to enforcement action pursuant to applicable City ordinance and resolutions and orders, including all implementing rules and regulations. Nothing in this Section shall relieve any person of the obligation to comply with the regulations or permits of the City, County, State, or Federal authority.

610.02 EROSION PREVENTION TECHNIQUES AND MEASURES

610.02.A GENERAL

1. The use of erosion prevention techniques shall be emphasized, rather than measures to control sediment. This shall be especially important on construction sites immediately before and during the rainy season. Erosion prevention techniques are designed to protect soil particles from the force of rain and wind so they will not erode. When land is disturbed at a construction site, the erosion rate accelerates dramatically.

2. Erosion prevention techniques include, but are not limited to, construction scheduling, ground cover, and matting. Erosion prevention measures include, but are not limited to, silt fences, sediment barriers, and settling basins. Both erosion prevention techniques and sediment control measures have appropriate uses. Sediment control measures are designed to capture soil particles after they are dislodged and to retain the soil particles on site. Studies have shown, however, that sediment control measures are less effective than erosion prevention techniques in preventing soil movement.

610.02.B TYPICAL TECHNIQUES AND MEASURES TO BE IMPLEMENTED

1. The following provides a brief summary of some of the basic required erosion prevention techniques and measures to be implemented within the City. Refer to the Standard Drawings, the Oregon DEQ guidelines, and the ODOT Erosion Control Manual for additional information and for other best management practices (BMPs).

2. GRAVEL CONSTRUCTION ENTRANCE

   a. A gravel construction entrance is required. If there is more than one vehicle access point, a gravel construction entrance shall be required at each entrance.

   b. The responsibility for design and performance of the driveway remains with the applicant. Vehicles or equipment shall not enter a property next to a stream, watercourse, stormwater or surface water facility, or wetlands unless adequate measures are installed to prevent physical erosion into the water or wetland.

3. GENERAL EROSION CONTROL MEASURES

   a. During periods of wet weather, disturbed areas of the site and/or stockpiled soil shall be covered by tarps or straw at the end of each day's operations; all disturbed, unworked areas of the site shall be protected from erosion.

   b. Temporarily seed disturbed soils and slopes that are not at finished grade and which will be exposed for two months or longer before being disturbed again.

   c. Where seeding is used for erosion control, Regreen® or equivalent, or sterile wheat shall be used to stabilize slopes until permanent vegetation is established.

   d. Temporary seeding shall establish a minimum of 70% coverage of the ground surface with uniform healthy plants. If this coverage is not achieved, or if the City determines that it is not effective in stabilizing the soil from erosion, the applicant, at their expense, will be required stabilize the area with other temporary stabilization methods as approved by the City Engineer.

   e. Biodegradable fabrics (Coir/Jute Matting), reinforced turf mats, or straw mulch can be used to stabilize slopes and channels. The fabrics can also be used to hold plugs in place and discourage floating upon inundation.

   f. Permanent vegetation or seeding shall be established only between March 1 through May 15 and September 1 through October 15. If an irrigation system is installed, vegetation or seeding may be established from March 1 through November 15. If an area falls under definition of a wetland, permanent vegetation or seeding shall be established only between March 1 through April 30 and September 1 through October 15 and in a manner satisfying applicable City, County, State and Federal requirements.

4. BIOENGINEERING TECHNIQUES

   a. Any person performing work in a watercourse or in an environmentally sensitive area (e.g., essential salmonid habitat, wetlands, steep slopes) shall employ bioengineering techniques whenever feasible.

   b. Bioengineering techniques include, but are not limited to, contour wattling, brush layering or matting, live cuttings, fascines, and stakes.

5. SEDIMENT FILTERS AND FENCES

   a. A sediment filter system may not be used on catch basins in public streets as part of erosion and sediment control plans for single-family dwellings.

   b. The use of sediment fences will be required. Sediment fences are not required on a site in the following circumstances, unless otherwise specifically required by the City Engineer:

      1) Where a Neighborhood Erosion and Sediment Control Plan (see Subsection 610.03.B) is in effect, for a maximum of four (4) lots.

      2) Where there are no concentrated flows and the slope being protected has a grade of less than 2 percent.

      3) Where flows are collected by using temporary or permanent grading or other means, such that the flows are routed to an approved settling pond, filtering system, or sediment barrier.

      4) Where there are no concentrated flows, where slopes are less than 10%, and where the runoff passes through a grassed area that is either owned by the applicant or where such use is allowed, by written agreement, by the owner of the grassed area. The grass area shall be at least equal in dimension to the project area.

      5) Where the surface is protected by ground cover or matting approved by the City Engineer.

   c. Using straw bales as a sediment filter, fence, or barrier is not allowed.

6. PLASTIC SHEETING

   a. Plastic sheeting shall generally not be used as an erosion control measure for single-family dwelling construction. Plastic sheeting may be used to protect small, highly erodible areas or temporary stockpiles of material. If plastic sheeting is used, the path of concentrated flow from the plastic must be protected.

7. DUST PREVENTION

   a. During all phases of the work, the applicant shall take precautions to abate any dust nuisance. Dust-prevention measures shall be continuous until final inspection by the City Engineer. Dust shall be minimized to the extent practicable, using all measures necessary to accomplish results satisfactory to the City Engineer, including, but not limited to:

      1) Sprinkling haul and access roads and other exposed dust-producing areas with water.

2) Applying City-approved dust palliatives on access and haul roads.

3) Establishing temporary vegetative cover.

4) Placing wood chips or other effective mulches on vehicle- and pedestrian-use areas.

5) Maintaining proper moisture conditions on all fill surfaces.

6) Prewetting cut and borrow area surfaces.

7) Using covered haul equipment

610.03 EROSION AND SEDIMENT CONTROL PLAN (ESCP)

610.03.A GENERAL

1. An Erosion and Sediment Control Plan (ESCP) is a detailed description of where and how activities will be implemented to control erosion, sediment, and pollutants on a development site. The ESCP is a central, specific component of the overall site development management plan. The ultimate goal of erosion prevention is to limit the time and area of ground disturbance, keep pollutants separate from stormwater runoff, and establish permanent groundcover as quickly and thoroughly as possible.

2. An ESCP shall be developed by a professional knowledgeable in erosion and sediment control. The responsible party shall designate an individual to be responsible for onsite installation, maintenance, and removal of ESCP measures. The ESCP shall be submitted and approved prior to any ground disturbance. Construction projects with ground disturbance of one (1) or more acres will require a NPDES 1200-C permit, as required by the Oregon Department of Environmental Quality.

3. A Certified Professional in Sediment and Erosion Control (CPESC) or a licensed Professional Engineer with the State of Oregon may be required to prepare the ESCP under a City issued permit for special sites or when a major plan revision is required because of site violations.

610.03.B ESCP REVIEW AND APPROVAL WHEN REQUIRED BY CITY PERMIT

- The City Engineer may deny a plan if it is determined that the plan does not meet the minimum ESCP requirements stated above and/or standard industry practices.
- Review of ESCPs will look for the following approval criteria:
  - Efforts to minimize area of disturbance.
  - Use of combination of BMP types, not just sediment controls. Good plans will include at least one type of BMP from each BMP group in the manual (site entry, perimeter, stormwater, erosion prevention, etc.).
  - Use of stabilized construction entrances away from the low points of sites. Use of multiple entrances for large sites.
  - A specific construction schedule.
  - Description of stormwater controls prior to storm sewer or infiltration system installation.
  - Description of vehicle storage, maintenance, and fueling practices. Designation of staging areas, if appropriate.
  - Description of designated and protected materials storage and stockpile areas.
  - Description of site inspection and maintenance requirements for all BMPs after any storm event.

- ❖ Approval of the ESCP is based on meeting the minimum requirements outlined in Subsection 610.03.C, in accordance with the anticipated site conditions and schedule. Approval of an Erosion and Sediment Control Plan by the City does not relieve the applicant's responsibility to ensure that the approved erosion control BMPs are constructed and maintained to contain sediment and pollutants on the construction site.
- ❖ During the construction period, measures in the ESCP shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment-laden water does not leave the site. Approval of a plan may be granted with or without restrictions. Restrictions on a plan may include, but shall not be limited to, the following:
  - Work is conducted only during a specified time of the year.
  - Only a portion of the work is approved.
  - Oversight by an erosion control professional is mandated.

1. NEIGHBORHOOD EROSION AND SEDIMENT CONTROL PLAN

   a. Any individual or group may submit an erosion and sediment control plan for multiple lots. Plans shall be submitted to the City Engineer for review and approval. This group plan shall be referred to as a "Neighborhood Erosion and Sediment Control Plan." In such case, the group of lots will be evaluated as if they were one lot.

   b. If an individual lot in a Neighborhood Erosion and Sediment Control Plan is sold to new owners, the new owners may either join the neighborhood plan (with the approval of the other neighborhood owners), or will need to submit their own erosion and sediment control plan if erosion potential still exists on the parcel. If a lot is sold and the new owner does not join the Neighborhood Erosion and Sediment Control Plan, then the plan must be revised and the new owner must submit an individual plan.

610.03.C ESCP DEVELOPMENT MINIMUM REQUIREMENTS

1. As part of the construction plans, an Erosion and Sediment Control Plan shall be developed in accordance with the following criteria, the Oregon DEQ guidelines, and the ODOT Erosion Control Manual. The ESCP shall meet the following minimum requirements:

   - ❖ Demonstrate compliance requirements set forth above in Subsection 610.01.
   - ❖ Show compliance with special requirements mandated by the City Engineer.
   - ❖ Identify any wetland, water body or outfalls within 200 feet of the ground-disturbing activity.
   - ❖ Provide a simplified narrative description of existing land uses and proposed land use. Provide a copy of any applicable land use review documents.
   - ❖ Provide clear delineation and approximate size of the area to be disturbed. Show existing and proposed ground contours. Provide drainage patterns for existing and final ground contours. In addition, provide drainage patterns for all intermediate contours throughout the length of the ground-disturbing activity.
   - ❖ Show drainage controls that will be used prior to installation of a final stormwater conveyance system.
   - ❖ Indicate the name and address of responsible parties, including the Developer and property owner.
   - ❖ Identify an emergency contact and telephone number.

- Provide a preliminary activity schedule (general construction schedule), including anticipated start and completion dates for all sequencing of ground-disturbing activity and the associated dates for installation of erosion, sediment, and pollution control BMPs. The activity schedule shall indicate the timeframe for installation, maintenance, and removal of temporary BMPs. The applicant is responsible for notifying the City when site work will deviate from the preliminary schedule. The preliminary schedule can be modified through the designated site inspector as work on the site progresses.
- Identify the application and maintenance of BMPs, including planning-level BMPs such as speed limits on interior roads.
- Show the location of erosion and sediment control BMPs and their position in relation to ground-disturbing activities. Identify which BMPs, if any, are permanent controls. Provisions shall be made for the interception of all potential silt-laden runoff that could result from the site clearing and grading. Interception shall preclude any silt-laden runoff from discharging from the proposed land development to downstream properties. Interception shall cause all silt-laden runoff to be conveyed by open ditch or other means to whatever temporary facility is necessary to remove silt prior to discharge to downstream properties.
- Identify development activities/areas with the potential to generate pollutants, such as vehicle maintenance, fueling, trash and debris collection, dewatering discharge, and top soil or other material stockpiles. Note whether any of these activities will occur offsite.
- Provide a simplified site landscape plan that indicates the types and amounts of vegetation to be used and when and where the vegetation will be planted. Distinguish between temporary vegetative cover and permanent site landscaping.
- Indicate on the site plan all areas of non-disturbance and/or retention of existing vegetation.
- For structural erosion and sediment control BMPs, provide a detail of installation methods, including any sizing calculations (flow volumes, rates, etc.) or reference to BMPs outlined in the Standard Drawings or in the ODOT Erosion Control Manual .
- Provide drainage calculations, when required by the City Engineer.

610.03.D ESCP DEVELOPMENT AND IMPLEMENTATION

1. The three principal parties involved in implementing an ESCP are the Designer, the Applicant or Designer's Inspector, and the Contractor. In addition to being responsible for reviewing the project's applicable NPDES 1200-C permit and knowing what is required, each has the following corresponding project responsibilities, which include, but not limited to the following:

   a. Designer Responsibilities:

      - Research construction project site conditions.
      - Ensure that topography and drainage are clearly delineated on the ESCP.
      - Understand the scope of the construction project including detour facilities, duration of construction, and time of year construction will commence.
      - Develop supplemental specifications as required to specify practices necessary to control erosion and contain sediment on site.
      - Provide an ESCP with proper erosion control items to address erosion and sediment throughout project construction.
      - Regularly update knowledge of the latest technology in commercial erosion control materials and methods.
      - Ensure that the specified erosion control products are readily available.

b. Applicant or Designer's Inspector Responsibilities:

- ❖ Have knowledge and understanding of the project ESCP and Pollution Control Plan (PCP).
- ❖ Ensure that the Contractor submits revisions to the ESCP and presents the revised ESCP at the pre-construction meeting.
- ❖ Ensure that the Contractor updates the ESCP as construction progresses.
- ❖ Ensure that the Contractor maintains the erosion control facilities as needed.
- ❖ Ensure that the Contractor completes monitoring reports weekly or after more than 0.5 inches (in) of rain in a 24-hour period during active projects and once every 2 weeks during inactive projects of more than 7 days, if required by the City.
- ❖ Understand Sections 00280 (Erosion and Sediment Control) and 01030 (Seeding) of the ODOT Standard Specifications for Construction for public improvement projects under City Contract.
- ❖ Understand how to properly implement best management practices (BMPs) to control erosion and contain sediment.
- ❖ Ensure that the Contractor and project complies with the NPDES 1200 Permit.
- ❖ Be familiar with the Standard Drawings for erosion control.

c. Contractor Responsibilities:

- ❖ Become knowledgeable about the latest technology to control erosion and contain sediment.
- ❖ Be knowledgeable of site conditions.
- ❖ Understand the ESCP and Sections 00280 (Erosion and Sediment Control) and 01030 (Seeding) of the ODOT Standard Specifications for Construction for public improvement projects under City Contract.
- ❖ Revise the ESCP to meet conditions of construction (i.e., phasing, timing, weather) and present the revisions at the pre-construction meeting.
- ❖ Develop a an ESCP that includes a site plan and narrative, describing methods of erosion and sediment control to be used to minimize erosion and sediment from project operations related to disposal sites, borrow pit operations, haul roads, equipment storage sites, fueling operations and staging areas.
- ❖ Construct BMP's as described in the project ESCP and specifications.
- ❖ Minimize clearing of vegetation and look for opportunities to minimize erosion, offering ideas to ODOT inspectors for approval.
- ❖ Monitor erosion control devices.
- ❖ Maintain erosion control facilities and modify when required to stay in compliance with NPDES 1200 Permit.
- ❖ Update the ESCP as work progresses and modify plan as conditions change.
- ❖ Ensure that permanent seeding is done within the time frames set forth in Section 01030 (Seeding) of the ODOT Standard Specifications for Construction for public improvement projects under City Contract.

610.03.E CITY INSPECTION OF EROSION CONTROL MEASURES

1. City Initial Inspection: On a site development or any other type of project, the erosion and sediment control measures shall be installed before the start of any permitted activity. The applicant shall coordinate with the City Engineer for a pre-construction conference before beginning any site clearing or grading.

2. City Final Inspection: A final erosion control inspection will be required before the removal of erosion and sediment control measurements.

610.03.F MAINTENANCE

1. The applicant shall maintain the facilities and techniques contained in the approved erosion and sediment control plan so they will continue to be effective during the construction phase, post construction phase, establishment of permanent vegetation, or any other permitted activity.

2. If the facilities and techniques approved in an erosion and sediment control plan are not effective or sufficient as determined by the City site inspection, the applicant shall submit a revised plan within three (3) working days of written notification by the City Engineer. On approval of the revised plan by the City Engineer, the applicant shall immediately implement the additional facilities and techniques included in the revised plan.

3. In cases where erosion is likely to occur, the City Engineer may require the applicant to install interim control measures before submitting a revised erosion and sediment control plan.

4. The erosion and sediment control measures shall remain in place and be maintained in good condition until all disturbed soil areas are permanently stabilized by installation and establishment of landscaping, grass, or mulching, or are otherwise covered and protected from erosion.

610.03.G WET WEATHER MEASURES

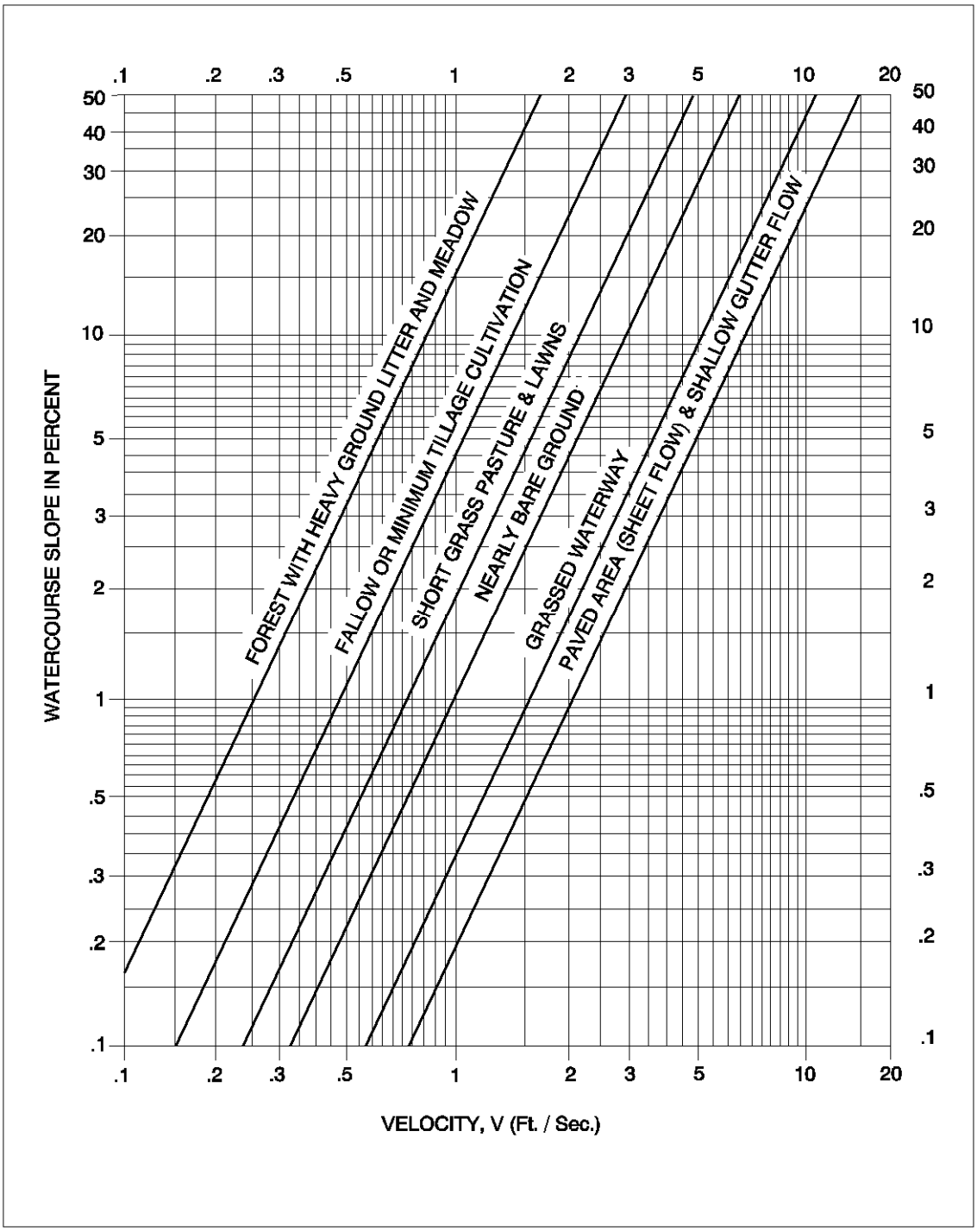
1. On sites where vegetation and ground cover have been removed, vegetative ground cover shall be planted on or before September 1, with the ground cover established by October 15. As an alternative if ground cover is not established by October 15, the open areas shall be protected through the winter with mulch, erosion blankets, or other method(s) approved by the City's authorized representative.

611 DESIGN ATTACHMENTS

END OF DIVISION

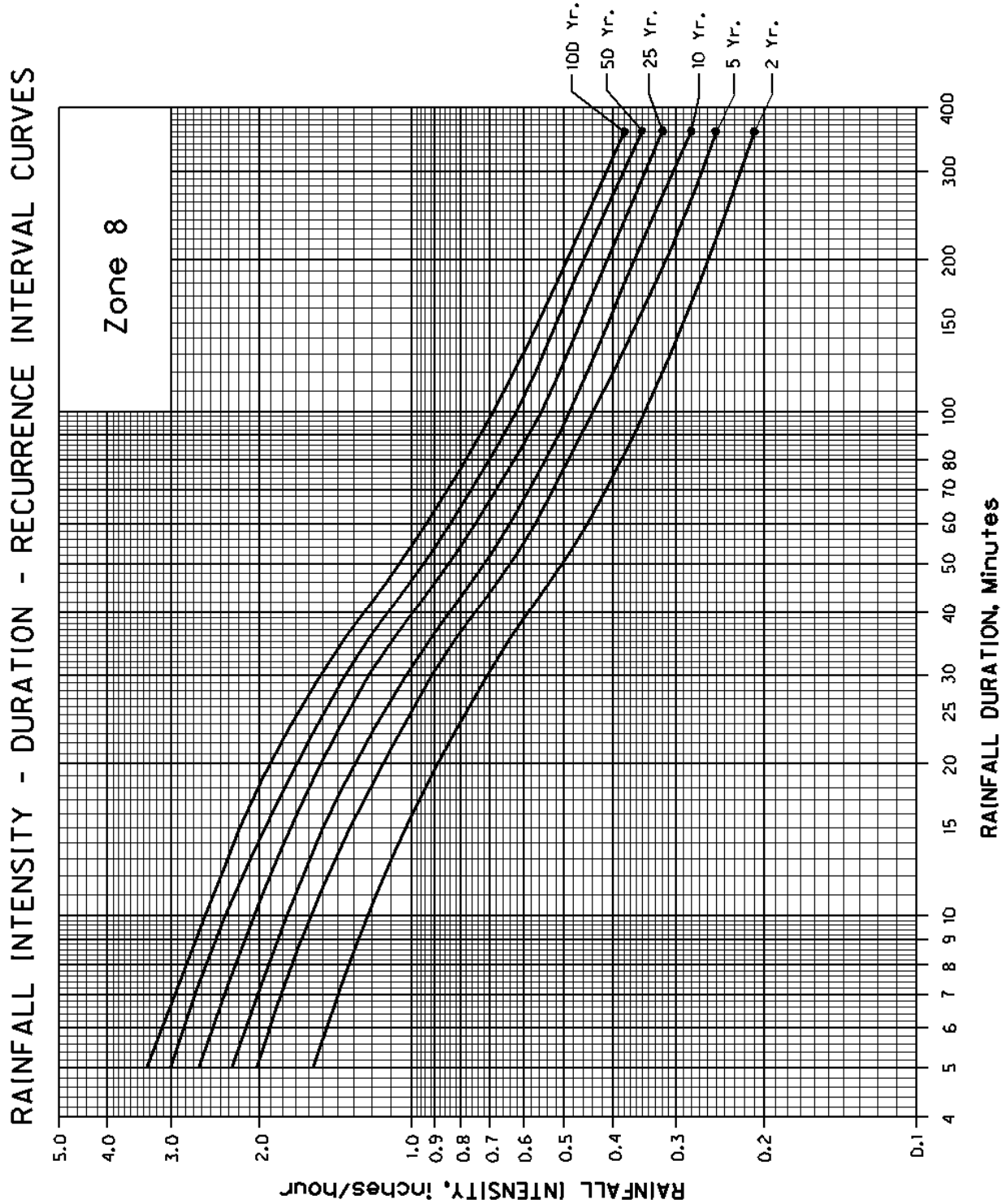
SHALLOW CONCENTRATED FLOW VELOCITIES

(source: ODOT Hydraulics Manual, 2005)



ODOT ZONE 8 IDF CURVE

(source: ODOT Hydraulics Manual, 2005)



NRCS RUNOFF CURVE NUMBERS

(source: City of Portland SWMM, 2008)

Runoff curve numbers for urban areas*

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area	A	B	C	D
Open space (lawns, parks, golf courses, cemeteries, etc.):					
Poor condition (grass cover <50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82

Runoff curve numbers for other agricultural lands*

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range-continuous forage for grazing					
<50% ground cover or heavily grazed with no mulch	Poor	68	79	86	89
50 to 75% ground cover and not heavily grazed	Fair	49	69	79	84
>75% ground cover and lightly or only occasionally grazed	Good	39	61	74	80
Meadow-continuous grass, protected from grazing and generally mowed for hay	-	30	58	71	78
Brush--weed-grass mixture with brush as the major element					
<50% ground cover	Poor	48	67	77	83
50 to 75% ground cover	Fair	35	56	70	77
>75% ground cover	Good	30	48	65	73
Woods-grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79

Runoff curve numbers for other agricultural lands*

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Woods					
Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.	Poor	45	66	77	83
Woods are grazed but not burned, and some forest litter covers the soil.	Fair	36	60	73	79
Woods are protected from grazing, and litter and brush adequately cover the soil.	Good	30	55	70	77

Runoff curve numbers for Simplified Approaches**

Cover description		Curve numbers for hydrologic soil group			
Simplified Approaches	Hydrologic condition	A	B	C	D
Eco-roof	Good	n/a	61	n/a	n/a
Roof Garden	Good	n/a	48	n/a	n/a
Contained Planter Box	Good	n/a	48	n/a	n/a
Infiltration & Flow-Through Planter Box	Good	n/a	48	n/a	n/a
Pervious Pavement	-	76	85	89	n/a
Trees					
New and/or Existing Evergreen	-	36	60	73	79
New and/or Existing Deciduous	-	36	60	73	79

n/a - Does not apply, as design criteria for the relevant mitigation measures do not include the use of this soil type.
*Soil Conservation Service, *Urban Hydrology for Small Watersheds*, Technical Release 55, pp. 2.5-2.8, June 1986.
**CNs of various cover types were assigned to the Proposed Simplified Approaches with similar cover types as follows:

Eco-roof – assumed grass in good condition with soil type B.
Roof Garden – assumed brush-weed-grass mixture with >75% ground cover and soil type B.
Contained Planter Box – assumed brush-weed-grass mixture with >75% ground cover and soil type B.
Infiltration & Flow-Through Planter Box – assumed brush-weed-grass mixture with >75% ground cover and soil type B.
Pervious Pavement – assumed gravel.
Trees – assumed woods with fair hydrologic conditions.

Note: To determine hydrologic soil type, consult local USDA Soil Conservation Service Soil Survey.

NRCS 24-HOUR TYPE 1A HYETOGRAPHIC DISTRIBUTION

(source: City of Portland SWMM, 2008)

Time From Start of Storm, Minutes		% Rainfall	Cumulative % Rainfall
0 -	10	0.40	0.40
10 -	20	0.40	0.80
20 -	30	0.40	1.20
30 -	40	0.40	1.60
40 -	50	0.40	2.00
50 -	60	0.40	2.40
60 -	70	0.40	2.80
70 -	80	0.40	3.20
80 -	90	0.40	3.60
90 -	100	0.40	4.00
100 -	110	0.50	4.50
110 -	120	0.50	5.00
120 -	130	0.50	5.50
130 -	140	0.50	6.00
140 -	150	0.50	6.50
150 -	160	0.50	7.00
160 -	170	0.60	7.60
170 -	180	0.60	8.20
180 -	190	0.60	8.80
190 -	200	0.60	9.40
200 -	210	0.60	10.00
210 -	220	0.60	10.60
220 -	230	0.70	11.30
230 -	240	0.70	12.00
240 -	250	0.70	12.70
250 -	260	0.70	13.40
260 -	270	0.70	14.10
270 -	280	0.70	14.80
280 -	290	0.82	15.62
290 -	300	0.82	16.44
300 -	310	0.82	17.26
310 -	320	0.82	18.08
320 -	330	0.82	18.90
330 -	340	0.82	19.72
340 -	350	0.95	20.67
350 -	360	0.95	21.62
360 -	370	0.95	22.57
370 -	380	0.95	23.52
380 -	390	0.95	24.47
390 -	400	0.95	25.42
400 -	410	1.34	26.76
410 -	420	1.34	28.10
420 -	430	1.34	29.44
430 -	440	1.80	31.24
440 -	450	1.80	33.04
450 -	460	3.40	36.44
460 -	470	5.40	41.84
470 -	480	2.70	44.54
480 -	490	1.80	46.34
490 -	500	1.34	47.68
500 -	510	1.34	49.02
510 -	520	1.34	50.36
520 -	530	0.88	51.24
530 -	540	0.88	52.12
540 -	550	0.88	53.00
550 -	560	0.88	53.88
560 -	570	0.88	54.76
570 -	580	0.88	55.64
580 -	590	0.88	56.52
590 -	600	0.88	57.40
600 -	610	0.88	58.28
610 -	620	0.88	59.16
620 -	630	0.88	60.04
630 -	640	0.88	60.92
640 -	650	0.72	61.64
650 -	660	0.72	62.36
660 -	670	0.72	63.08
670 -	680	0.72	63.80
680 -	690	0.72	64.52
690 -	700	0.72	65.24
700 -	710	0.72	65.96
710 -	720	0.72	66.68
720 -	730	0.72	67.40
730 -	740	0.72	68.12
740 -	750	0.72	68.84
750 -	760	0.72	69.56
760 -	770	0.57	70.13
770 -	780	0.57	70.70
780 -	790	0.57	71.27
790 -	800	0.57	71.84
800 -	810	0.57	72.41
810 -	820	0.57	72.98
820 -	830	0.57	73.55
830 -	840	0.57	74.12
840 -	850	0.57	74.69
850 -	860	0.57	75.26
860 -	870	0.57	75.83
870 -	880	0.57	76.40
880 -	890	0.50	76.90
890 -	900	0.50	77.40
900 -	910	0.50	77.90
910 -	920	0.50	78.40
920 -	930	0.50	78.90
930 -	940	0.50	79.40
940 -	950	0.50	79.90
950 -	960	0.50	80.40
960 -	970	0.50	80.90
970 -	980	0.50	81.40
980 -	990	0.50	81.90
990 -	1000	0.50	82.40
1000 -	1010	0.40	82.80
1010 -	1020	0.40	83.20
1020 -	1030	0.40	83.60
1030 -	1040	0.40	84.00
1040 -	1050	0.40	84.40
1050 -	1060	0.40	84.80
1060 -	1070	0.40	85.20
1070 -	1080	0.40	85.60
1080 -	1090	0.40	86.00
1090 -	1100	0.40	86.40
1100 -	1110	0.40	86.80
1110 -	1120	0.40	87.20
1120 -	1130	0.40	87.60
1130 -	1140	0.40	88.00
1140 -	1150	0.40	88.40
1150 -	1160	0.40	88.80
1160 -	1170	0.40	89.20
1170 -	1180	0.40	89.60
1180 -	1190	0.40	90.00
1190 -	1200	0.40	90.40
1200 -	1210	0.40	90.80
1210 -	1220	0.40	91.20
1220 -	1230	0.40	91.60
1230 -	1240	0.40	92.00
1240 -	1250	0.40	92.40
1250 -	1260	0.40	92.80
1260 -	1270	0.40	93.20
1270 -	1280	0.40	93.60
1280 -	1290	0.40	94.00
1290 -	1300	0.40	94.40
1300 -	1310	0.40	94.80
1310 -	1320	0.40	95.20
1320 -	1330	0.40	95.60
1330 -	1340	0.40	96.00
1340 -	1350	0.40	96.40
1350 -	1360	0.40	96.80
1360 -	1370	0.40	97.20
1370 -	1380	0.40	97.60
1380 -	1390	0.40	98.00
1390 -	1400	0.40	98.40
1400 -	1410	0.40	98.80
1410 -	1420	0.40	99.20
1420 -	1430	0.40	99.60
1430 -	1440	0.40	100.00